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STING INTERFERENCE EFFECTS ON THE SDM AIRCRAFT AS DETERMINED BY--ETC(U)
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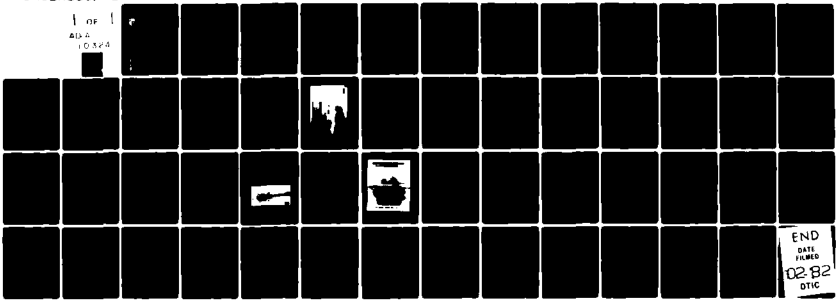

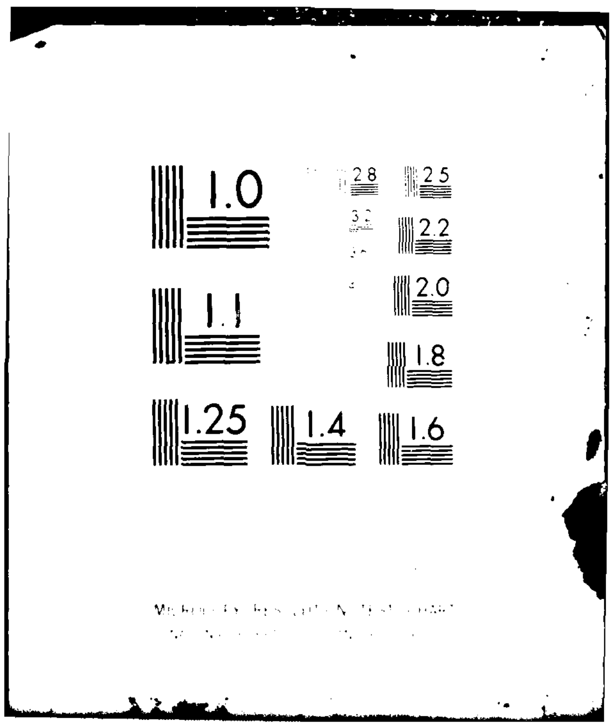
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LEVEL II

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STING INTERFERENCE EFFECTS ON THE SDM AIRCRAFT AS DETERMINED BY MEASUREMENTS OF DYNAMIC STABILITY DERIVATIVES AND BASE PRESSURE FOR MACH NUMBERS 0.3 THROUGH 1.3

F. B. Cyran and M. J. Chaney

ARO, Inc.

October 1980

Final Report for Period June 2, 1980 - September 10, 1980

ARNOLD ENGINEERING DEVELOPMENT CENTER
ARNOLD AIR FORCE STATION, TENNESSEE
AIR FORCE SYSTEMS COMMAND
UNITED STATES AIR FORCE

APPROVAL STATEMENT

This report has been reviewed and approved.

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Approved for publication:

FOR THE COMMANDER

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Deputy for Operations

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

An investigation was conducted to determine the effects of sting-support interference on the measurement of pitch damping, yaw-damping, pitching-moment slope, yawing-moment slope, pitching moment, and base pressure. The model was the Standard Dynamics Model (SDM). The forced oscillation technique was used to obtain data at Mach numbers 0.3 to 1.3 and Reynolds numbers, based on the model mean aerodynamic chord (MAC), of 0.3 million to 3.1 million. Amplitudes of oscillation were 1.0, 1.5, and 2.0 deg, and the reduced frequency parameter

20. ABSTRACT (Continued)

ranged from 0.009 to 0.032 radians. The test was conducted at a nominal oscillation frequency of 5.2 Hz. Data were obtained at angles of attack from -6 to 25 deg. The effective sting length was varied from 1 to 6 model diameters for sting diameters of 0.40, 0.65, and 0.73 model diameters. The data shows that sting interference effects are most pronounced near Mach number 1.0 and are more subtle at subsonic and low supersonic Mach numbers.

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CONTENTS

APPENDIXES

NOMENCLATURE

A	Reference area, 0.90702 ft^2
AD	Rate of change of angle of attack, rad/sec
A/D	Analog to digital
ALFI	Model support angle of attack, deg
ALPHA	Model angle of attack, deg
AMAPS	Automatic Model Attitude Positioning System
B	(a) Bias limit or
	(b) Wing span, 1.65 ft
BD	Rate of change of angle of sideslip, rad/sec
BETA	Sideslip angle in the stability axis system, deg
CBAR	Wing mean aerodynamic chord, 0.62233 ft
CG	Model center of gravity
CLM	Total pitching-moment coefficient, pitching moment/Q•A•CBAR
CLM-A	Slope of CLM versus ALPHA curve obtained from frequency measurements, rad^{-1}
CLM-AD	$\partial(CLM)/\partial \frac{(AD)(CBAR)}{2V}$, rad^{-1}
CLM-C	CLM corrected for tunnel flow anomalies (not used)
CLM-Q	$\partial(CLM)/\partial \frac{(Q')(CBAR)}{2V}$, rad^{-1}
CLM-QAD	Pitch-damping coefficient, (CLM-Q)+(CLM-AD), rad^{-1}
CLN	Total yawing-moment coefficient, yawing moment/Q•A•B
CLN-B	Slope of CLN versus BETA curve obtained from frequency measurements, rad^{-1}
CLN-BD	$\partial(CLN)/\partial \frac{(BD)(B)}{2V}$, rad^{-1}

CLN-R	$\partial(\mathrm{CLN})/\partial \frac{(R)(B)}{2V}$, rad^{-1}
CLN-RBD	Yaw-damping coefficient, (CLN-R)-(CLN-BD)•cos ALPHA, rad^{-1}
CODE or CONFIG	Configuration code number
CONFIG	Model configuration designation
D	Reference diameter, (model fuselage diameter), 0.36458 ft
DATE	Date that data were obtained
DDAS	Digital Data Acquisition System
DELE	Stabilator deflection, positive trailing edge down, deg
DS/D	Sting diameter to model base diameter ratio
FREQ	Frequency of oscillation, Hz
F.S.	Model fuselage station
GAMMA, GAM-M	Phase angle between the forcing moment and the angular displacement, deg
IY	Mass moment of inertia about the pivot axis, slug-ft^2
L	Reference length, model fuselage length, 2.55208 ft
L.E.	Leading edge
LS/D	Sting length to model base diameter ratio
M	Free-stream Mach number
MAC	Model mean aerodynamic chord, 0.62233 ft (same as CBAR)
OC	Oscillatory component
P	Free-stream static pressure, psf or psi
PB	Base pressure, psfa
PB1, PB2	Ratio of base pressure to free-stream static pressure
PHI-I	Model support roll angle, deg
PN	Data point number
POS	Total amplitude of the model oscillation vector, deg

PROJECT	Project number, P41C-H7
PT	Free-stream total pressure, psfa
Q	Free-stream dynamic pressure, psf
Q´	Angular velocity in pitch, rad/sec
RE	Free-stream unit Reynolds number, million/ft
REL	Free-stream Reynolds number based on CBAR, million
RFP	Reduced frequency parameter ((OMEGA-W)•CBAR/2•V) for pitch oscillation and ((OMEGA-W)•B/2•V) for yaw oscillation, radian
RHO	Free-stream density, slugs/ft^3
RUN	Run number
S	Sample standard deviation
SC	Static component
SDM	Standard Dynamics Model
T	Free-stream static temperature, °R or °F
T.E.	Trailing edge
THETS	Sting flare angle, 15 deg
TT	Free-stream total temperature used in data reduction, °F or °R
t_{95}	The 95th percentile point for the two-tailed Student's "t" distribution
U	Measurement uncertainty
V	Free-stream velocity, ft/sec
W.L.	Model water line
WT	Model weight, lb
XBAR	Distance from model c.g. to dynamic balance pivot center, in. or ft

1.0 INTRODUCTION

The work reported herein was sponsored by the Arnold Engineering Development Center (AEDC), Air Force Systems Command (AFSC), Arnold Air Force Station, Tennessee, under Program Element 65807F, and Control Number 9R02-00-0. The results were obtained by ARO, Inc., AEDC Group (a Sverdrup Corporation Company), operating contractor for the AEDC. The test was conducted in the Propulsion Wind Tunnel Facility (PWT) Aerodynamic Wind Tunnel (4T) under ARO Project No. P41C-H7 from June 2 to September 10, 1980. This test provided data in support of the research project "AEDC Dynamic Stability," ARO Project Number V32F-09. The AEDC Research Monitor was Capt. Al R. Obal (CF), and the Test Project Monitor was Mr. Tony D. Buchanan of ARO, Inc. This work is a continuation of the work reported in Ref. 1.

The objective of the test was to determine sting-support interference effects on the measurements of static and dynamic stability derivatives and base pressure on the Standard Dynamics Model (SDM). This included: (1) defining critical sting length by the measurement of pitch-damping derivatives and yaw-damping derivatives for three sting diameters and various model oscillation amplitudes, and (2) obtaining baseline pitch and yaw static and dynamic stability data on the SDM for two center of gravity (CG) locations.

Data were obtained at model oscillation amplitudes of 1.0, 1.5, and 2.0 deg using the VKF (von Kármán Facility) 1.C Forced Oscillation Test Mechanism. The frequency of oscillation was nominally 5.2 Hz. Data were obtained at angles of attack from -6 to 25 deg at Mach numbers 0.3 to 1.3. The sting length was effectively varied from 1 to 6 model diameters by extending a conical flare to various stations along the sting for sting diameters of 0.40, 0.65 and 0.73 model diameters. The Reynolds number per foot ranged from 0.5×10^6 to 5.0×10^6 and the reduced frequency parameter varied from 0.009 to 0.032. In addition, limited amounts of flow visualization data were obtained for several configurations and test conditions.

A microfilm copy of the final data has been retained in PWT at AEDC. Inquiries to obtain copies of the test data should be addressed to AEDC/DOT, Arnold Air Force Station, Tennessee 37389.

2.0 APPARATUS

2.1 TEST FACILITY

The Aerodynamic Wind Tunnel (4T) is a closed-loop, continuous flow variable-density tunnel in which the Mach number can be varied from 0.1 to 1.3 and can be set at discrete Mach numbers of 1.6 and 2.0 by placing nozzle inserts over the permanent sonic nozzle. At all Mach numbers, the stagnation pressure can be varied from 400 to 3400 psfa. The test section is a 4-ft square and 12.5 ft long with perforated, variable porosity (0.5- to 10-percent open) walls. It is completely enclosed in a plenum chamber from which the air can be evacuated, allowing part of the tunnel airflow to be removed through the perforated walls of the test section.

The model support system consists of a sector and boom attachment which has a pitch angle capability of -7.5 to 28 deg with respect to the tunnel centerline and a roll capability of -180 to 180 deg about the sting centerline. The general arrangement of the test section with the test article installed is shown in Fig. 1. A more complete description of the tunnel may be found in Ref. 2.

2.2 TEST ARTICLE

The Standard Dynamics Model (SDM) represents a 1/18-scale type fighter aircraft. Dimensions of the SDM are shown in Fig. 2, and details are shown in Fig. 3. The model has a 19.8-in. wing span and double-taper leading and trailing edges on the wing, stabilators and vertical tail. The stabilators may be deflected in increments of ±5 deg. All external components, i.e., wings, stabilators, inlet, ventral fins, canopy, etc., may be removed for buildup test as desired. Table 1 lists the configuration codes for the test reported herein. Design and fabrication were performed at AEDC.

For the smallest sting diameter configuration (DS/D = 0.40), the sting length was effectively shortened by positioning a conical steel flare (Fig. 4) at 2.0, 3.0, 4.0, 5.0, 5.6, and 5.7 model diameters to the rear of the model base along the sting. The effective sting length was 6.0 model diameters without the conical steel flare installed. The flare was mounted to the motor housing of the test mechanism without touching the sting forward of the motor housing.

For the larger sting diameter configurations (DS/D = 0.65 and 0.73) the steel conical flare was positioned fully aft of the model (up against the motor housing as shown in Fig. 4b). Two different sets of split tubes were mounted to the front end of this flare. These sting diameter configurations are shown in Fig. 5. The tubes were designed in two halves to facilitate installation of the tubes without removing the model. The split tubes were installed such that the parting line of the tubes was in the vertical plane. The sting length was effectively shortened by positioning a Lexan® flare on the split tubes at 1.0, 2.0, 3.0, and 4.0 model diameters to the rear of the model base along the sting. The effective sting length was 5.6 model diameters without the Lexan flare installed. No part of the sting diameter hardware touched the sting forward of the motor housing, even though the sting was subject to static and dynamic deflections within the tubes.

2.3 TEST MECHANISM

The VKF 1.C Forced-Oscillation Test Mechanism (Fig. 6) utilizes a cross-flexure pivot, an electric shaker motor and a one-component moment beam which is instrumented with strain gages to measure the forcing moment of the shaker motor. The motor is coupled to the moment beam by means of a connecting rod and flexural linkage which converts the translational force to a moment to oscillate the model at amplitudes up to 3 deg (depending on flexure balance) and frequencies from 2 to

8 Hz. The cross flexures, which are instrumented to measure the pitch/yaw displacement, support the model loads and provide the restoring moment to cancel the inertia moment when the system is operating at its natural frequency. The moment beam is not subjected to the static loads and can be made as sensitive as required for the dynamic measurements.

Data from this test were obtained with the 0.180-in.-thick cross flexures, which have a stiffness of 962.5 ft-lb/rad. The moment beam used to measure the pitch-damping moments had a thickness of 0.047 in. and it is capable of measuring a total moment of 11.3 in.-lb. For measuring the yaw-damping moments, the moment beam thickness was 0.036 in., which is capable of measuring a total moment of 7.1 in.-lb.

The cross-flexure pivot, moment beam, and flexural linkage assembly are supported by a long, slender cylindrical sting with a 1-deg taper. The sting is instrumented with strain gages to measure the static and oscillatory deflections of the sting in both the pitch and yaw plane. A penumatic- and spring-operated locking device is provided on the balance to hold the model during tunnel startup and shutdown.

2.4 TEST INSTRUMENTATION

2.4.1 Forced-Oscillation Instrumentation

The forced-oscillation instrumentation (Ref. 3) utilizes an electronic analog system with precision electronics. The control, monitor, and data acquisition instrumentation is contained in a portable console that can be easily interfaced with the instrumentation of the various wind tunnels at AEDC. The control instrumentation provides a system which can vary the oscillation amplitude of the model within the flexure limits. The oscillation amplitude is controlled by an electronic feedback loop which permits testing of both dynamically stable and unstable configurations. Data are normally obtained at or near the natural frequency of the model flexure system; however, the electronic resolvers permit data to be obtained off resonance.

All gages are excited by d-c voltages, and outputs are increased to optimum values by d-c amplifiers. Typical balance outputs from an oscillating model are composed of oscillatory components (OC) superimposed on static components (SC). These components are separated by bandpass and lowpass filters. The SC outputs are used to calculate the static moment coefficients and static sting deflections. The OC outputs are input to the resolver instrumentation and precise frequency measuring instrumentation. The resolvers utilize very accurate analog electronic devices to process the OC signals and output d-c voltages. The output d-c voltages are proportional to the amplitude squared, the in-phase and quadrature (90 deg out-of-phase) balance components (forcing torque), and the in-phase and quadrature sting components. An analog-to-digital (A/D) converter converts these outputs to digital signals. The data are recorded for a selected interval from approximately 2 to 60 sec at a sample rate appropriate to the type test and wind tunnel.

2.4.2 Model Base Pressure Instrumentation

Model base pressures were measured with 2 Sunstrand (Kistler) 314D Servo Pressure transducers located on the tunnel plenum chamber wall. The locations of the orifices with respect to the model and sting are shown in Fig. 7.

2.4.3 Flow Visualization Photographs

A camera was installed on the top and side wall of the tunnel to provide flow visualization data. Fluorescent tufts were attached to the upper port side horizontal stabilizer of the model, and photographs from both the top and side cameras were obtained using an ultraviolet flash. A typical photograph obtained in this manner is shown in Fig. 8.

3.0 TEST DESCRIPTION

3.1 TEST CONDITIONS AND PROCEDURES

3.1.1 General

A summary of the nominal test conditions at each Mach number is listed below.

M	PT, psfa	TT, °F	Q, psf	P, psf	V, ft/sec	$REx10^{-6}, ft^{-1}$	$RELx10^{-6}$
0.30	575	102	34	540	346	0.5	0.3
0.30	1112	89	66	1045	342	1.0	0.6
0.30	2017	111	118	1867	349	1.7	1.0
0.30	2966	123	180	2812	354	2.5	1.6
0.30	3670	132	217	3441	355	3.0	1.9
0.60	641	99	127	503	671	1.0	0.6
0.60	1608	103	318	1261	674	2.5	1.6
0.60	3374	123	664	2642	685	5.0	3.1
0.80	723	84	212	474	861	1.4	0.9
0.95	486	91	172	273	1004	1.0	0.6
0.95	754	102	267	420	1019	1.5	0.9
0.95	823	86	291	460	1002	1.7	1.0
0.95	1207	89	427	676	1004	2.5	1.6
1.05	849	88	326	424	1089	1.8	1.1
1.05	1201	98	463	596	1104	2.5	1.6
1.10	1196	97	474	561	1141	2.5	1.6
1.20	983	90	409	409	1215	2.1	1.3
1.30	1200	94	512	434	1296	2.5	1.6

Testing procedures for yaw oscillation were identical to those for pitch oscillation, except that the test mechanism has rolled +90 deg from the pitch plane to the yaw plane. In addition, guy rod stiffeners were attached to the sector and boom assembly to help dampen vibration of the boom in yaw during the yaw phase. Flow visualization photographs were only obtained during the pitch phase.

Definition of the configuration code is given in Table 1. The test summary is given in Table 2.

3.1.2 Data Acquisition

After establishing tunnel conditions and model attitude, the model was unlocked, and brought to a constant oscillation amplitude of 1 or 2 deg by using the Forced-Oscillation Control System. The system was allowed to stabilize at the system resonant frequency before data were recorded. At each angle of attack, generally one data point was taken. Data were obtained over a 30-second time interval at each data point. The balance and sting gage outputs and frequency instrumentation were read from the forced-oscillation instrumentation console by a Digital Data Acquisition System (DDAS), at a rate of approximately 200 samples per second.

The Automatic Model Attitude Positioning System (AMAPS) was used to control the model position. A list of model angle-of-attack requirements was programmed into the AMAPS prior to the test. After data were obtained at a given angle of attack, the AMAPS was manually activated, and the model was automatically pitched to the next angle of attack on the AMAPS list.

At test conditions where flow visualization photographs were obtained, both top and side photographs were obtained simultaneously after tunnel conditions were established and prior to unlocking the model.

3.2 DATA REDUCTION

Data from the DDAS were combined with tunnel model attitude and base pressure instrumentation data and sent directly to a DEC-10 System Computer. Average values of the balance and sting gage outputs were calculated by the computer and used in conjunction with the remaining DDAS outputs to calculate the dynamic derivatives. Both the SC and OC sting gage outputs were used to correct the data for sting bending effects. The method used to reduce the data is given in Refs. 3 and 4.

A printout of each reduced data point was obtained approximately 2 minutes (real time) after the DDAS sent the unreduced data to the computer. Summary data were printed out at the conclusion of each angle-of-attack sweep. Reduced data were also plotted during the test, using the IBM-370 computer Interactive Graphics System, which received the reduced data from the DEC-10. Usually, the data were available for plotting on the IBM-370 Graphics System within the same amount of time (2 minutes real time) as the reduced data printout. This enabled close monitoring of the data during the angle-of-attack sweep and allowed cross plots (cross checks) to be made with similar configurations obtained earlier in the test.

3.3 UNCERTAINTY OF MEASUREMENTS

In general, instrumentation calibrations and data uncertainty estimates were made using methods recognized by the National Bureau of Standards (NBS) (Ref. 5). Measurement uncertainty is a combination of bias and precision errors defined as:

$$U = \pm (B + t_{95}S)$$

where B is the bias limit, S is the sample standard deviation, and t_{95} is the 95th percentile point for the two-tailed Student's "t" distribution, which for degrees of freedom greater than 30 equals 2.

Estimates of the measured data uncertainties for this test are given in Table 3a and b. The balance data uncertainties were determined from in-place static and dynamic calibrations through the data recording system and data reduction program. Static load hangings on the balance simulate the range of loads and center-of-pressure locations anticipated during the test, and measurement errors are based on differences between applied loads and corresponding values calculated from the balance equations used in the data reduction. Load hangings to verify the balance calibrations are made in place on the assembled model. Static and dynamic calibrations of the dynamic stability balance system allowed the measurement uncertainty to be that which is due to the amount of nonrepeatability of the calibration constants. The sting and parts of the balance not dynamically calibrated were calibrated by static load hangings over the range of anticipated loads. Uncertainties in the measurements of sting effects were included in the error analysis. Structural damping values were obtained near vacuum conditions before the tunnel flow was started to evaluate the still-air damping contribution.

Propagation of the bias and precision errors of measured data through the calculated data was made in accordance with Ref. 6, and the results are given in Table 3c. The uncertainties are for steady-state conditions. Occasionally vibration and noise of the wind tunnel environment caused the scatter in the data to exceed the estimated uncertainty.

4.0 DATA PACKAGE PRESENTATION

The data include tabulated and plotted data, a test summary, and flow visualization photographs. Tabulated data include summary data, point-by-point data, wind-off tare data, zeros data, torque calibration data, and a listing of constants. Plotted data include (1) individual plots of CLM-QAD, CLN-RBD, CLM-A, CLN-B, CLM, and PB1 data as a function of angle of attack, and (2) comparison plots which depict sting length ratio (LS/D), Reynolds number, oscillation amplitude, sting diameter ratio (DS/D), and configuration effects. A sample of the tabulated data and plotted data is presented in Appendix III.

The data package is comprised of the following four volumes:

Volume No.	Run Nos.	Description
1	31-221	Summary data (pitch phase only)
2	297-437	Summary data (yaw phase only)
3	31-221	Plotted Data (pitch phase only)
4	297-437	Plotted Data (yaw phase only)

Plots of CLM-QAD, CLM-A, and CLM are shown in Fig. 9. Theoretical DATCOM (Ref. 6) predictions are compared with the experimental data; comparisons are favorable at the lower angles of attack. The CLM-A data compare well with the data obtained from a curve-fit of CLM versus ALPHA.

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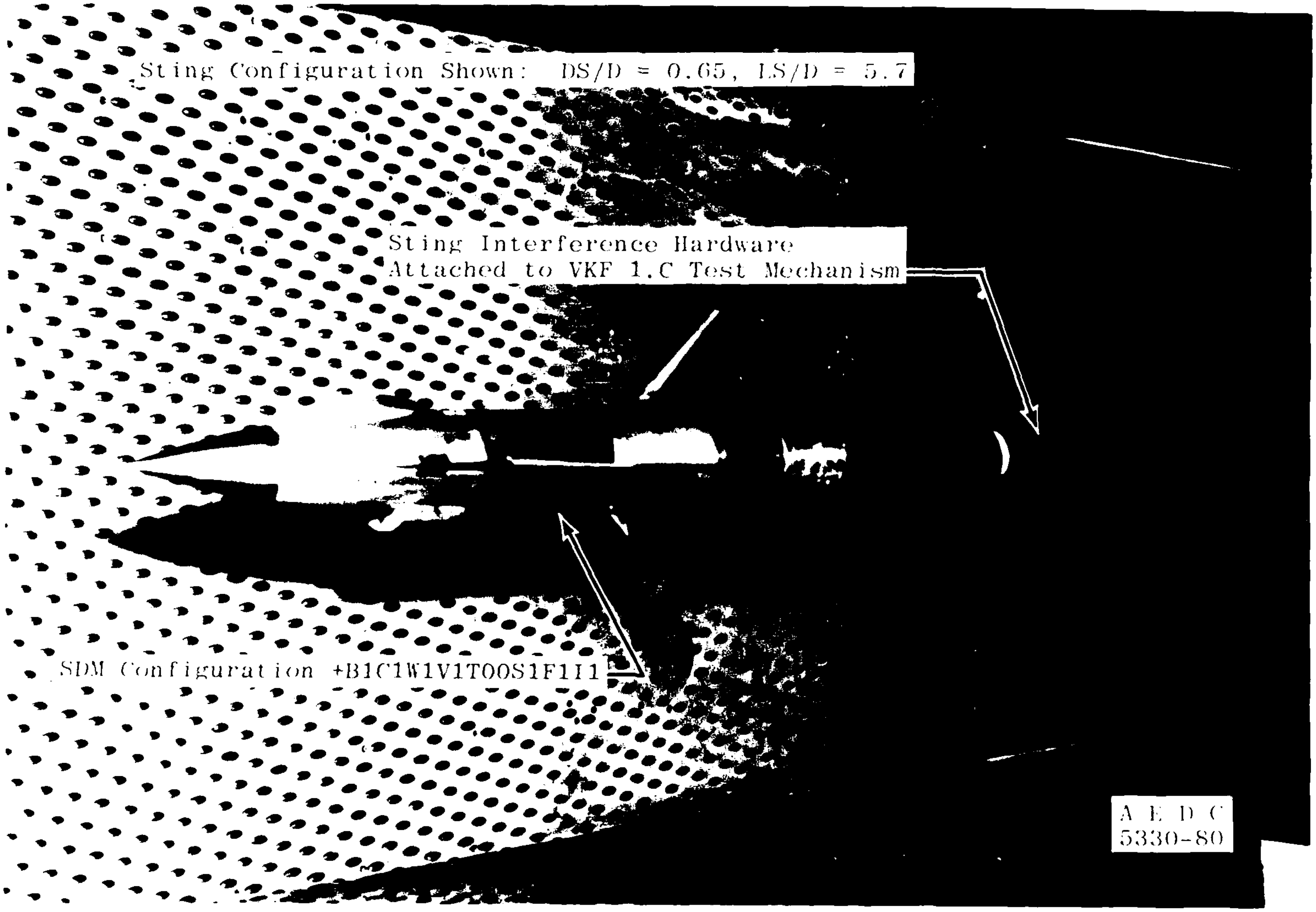
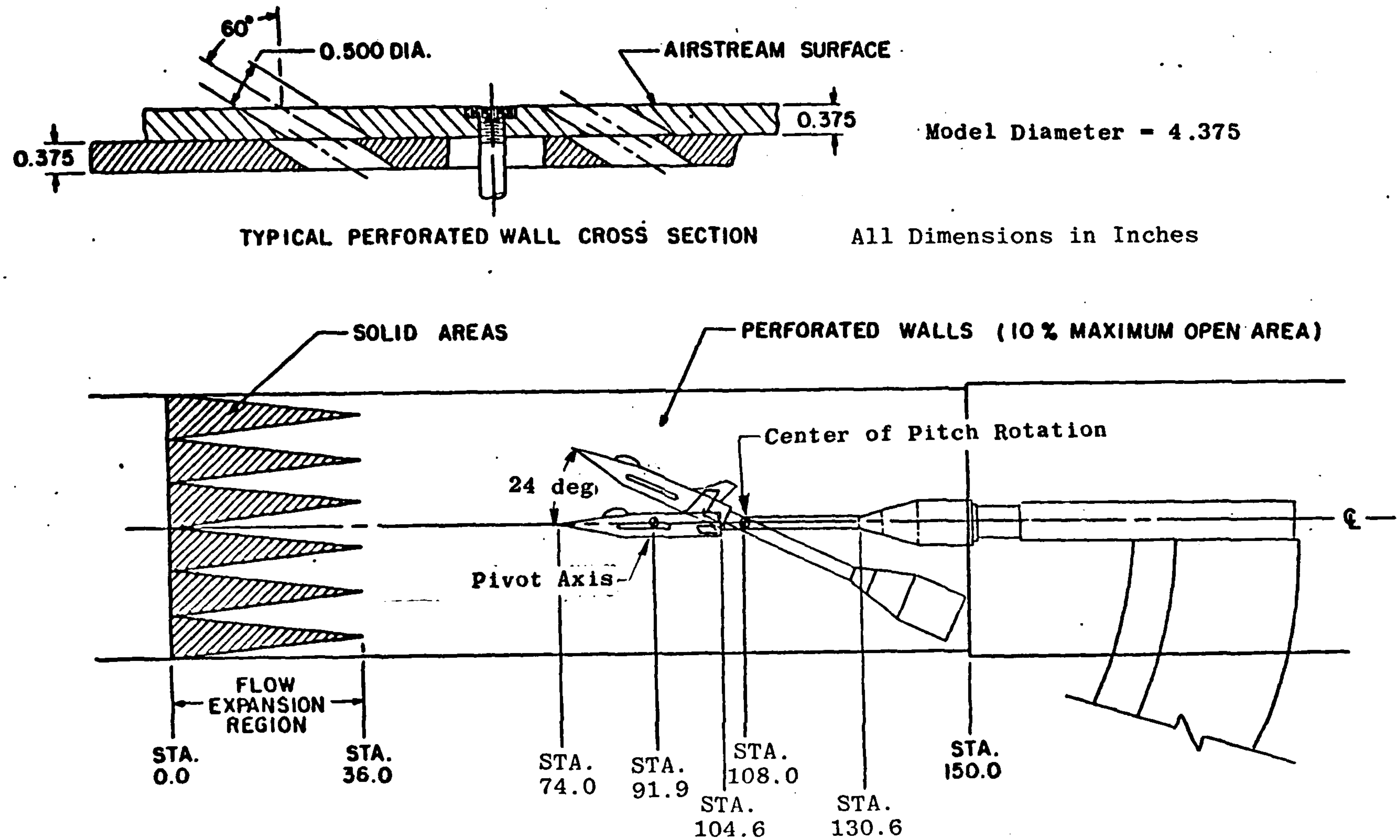
6. "USAF Stability and Control DATCOM," Flight Control Division, Air Force Dynamics Laboratory, Wright Patterson Air Force Base, revised January 1975.

APPENDIX I

ILLUSTRATIONS



a. Installation Photograph
Fig. 1 General Installation Arrangement

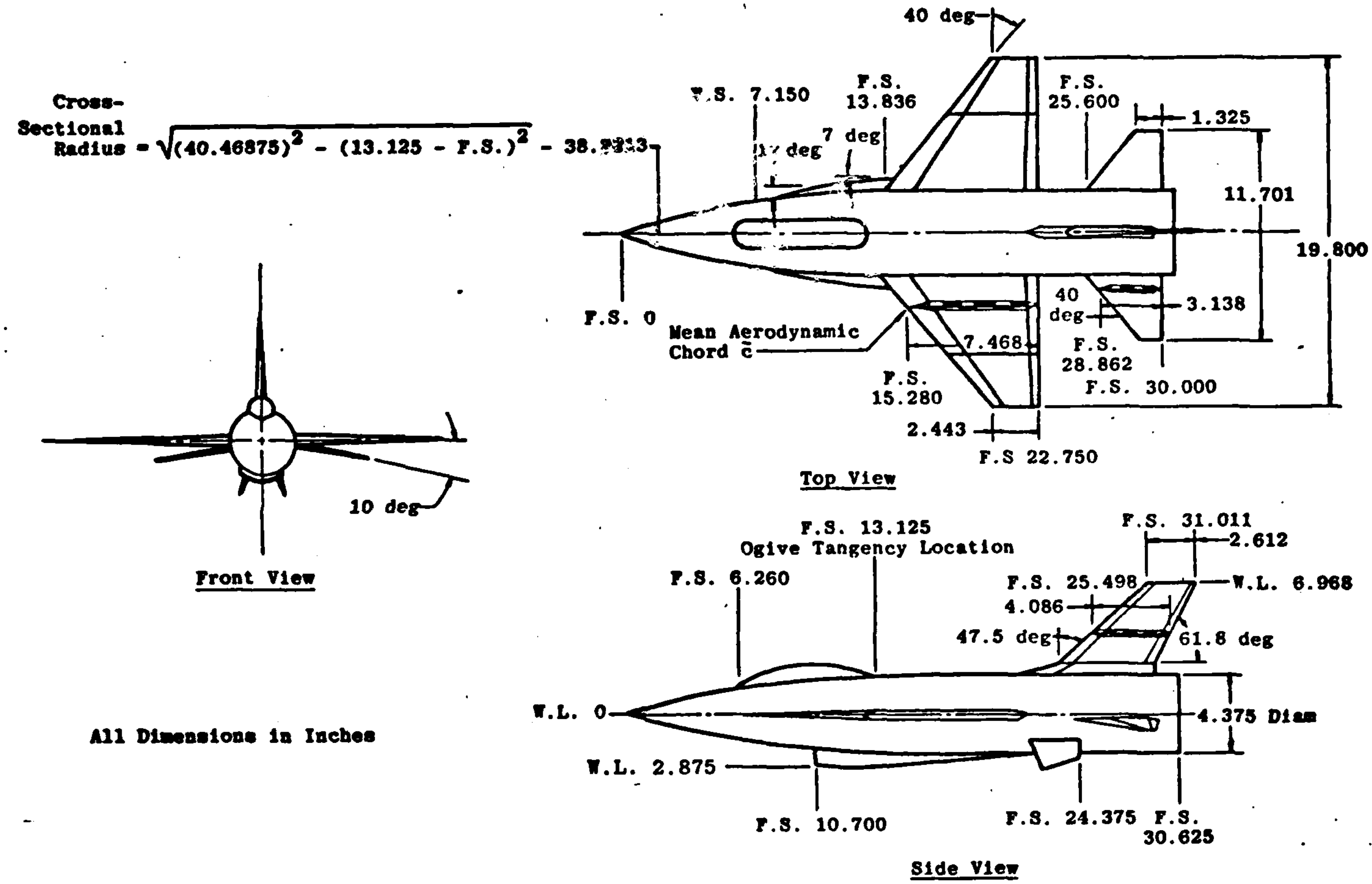


b. Installation Sketch

Fig. 1 Concluded

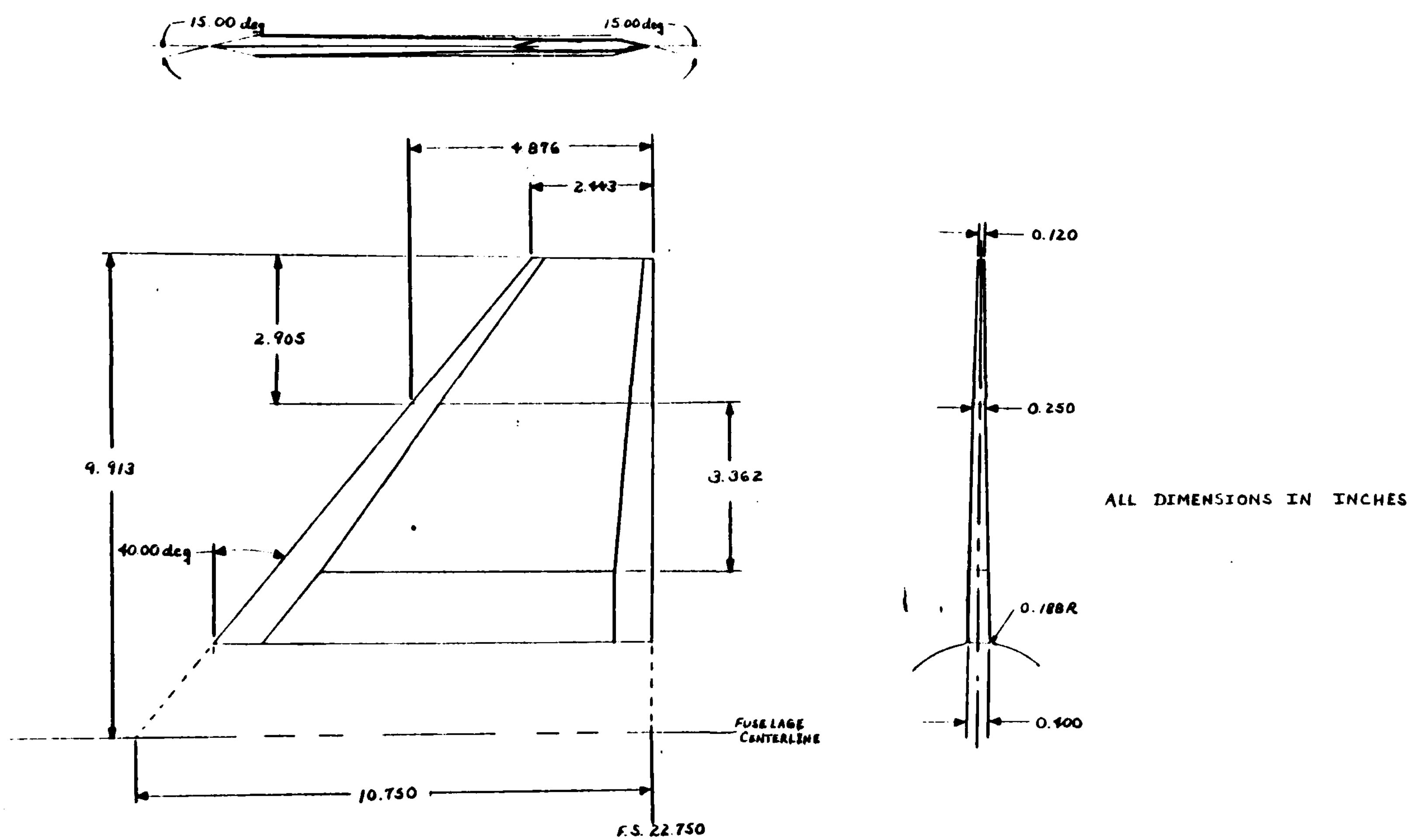
WING		
Area		0.90702 ft^2
Span		1.6500 ft
MAC		0.62233 ft
Aspect Ratio		3.0
L.E. Sweep		40 deg
Dihedral		0
Incidence		0
Airfoil	Double	Wedge 4.5 percent thickness at root.
L.E. Angle		15 (half angle)
T.E. Angle		15 (half angle)
HORIZONTAL TAIL		
Area		0.30707 ft^2
Aspect Ratio		3.0
Taper Ratio		0.213
L.E. Sweep		40 deg
Dihedral		-10 deg
Airfoil	Double	Wedge 6.4 percent thickness at root.
L.E. Angle		14 deg (half angle)
T.E. Angle		15 deg (half angle)
VERTICAL TAIL		
Area		0.30846 ft^2
Aspect Ratio		1.093
Taper Ratio		0.362
L.E. Sweep		
Tip		47.5 deg
Root		15.0 deg
Airfoil	Double	Wedge 5.6 percent thickness at root.
L.E. Angle		15 deg (half angle)
T.E. Angle		15 deg (half angle)
VENTRAL FIN (Each)		
Area		0.0263 ft^2
Span		0.150 ft
Aspect Ratio		0.86
Taper Ratio		0.70
L.E. Sweep		26.5 deg
Dihedral (cant)		25.2 deg (outboard)
Airfoil		
At Root	Modified	Wedge 3.8 percent thick at root.
At Tip		Constant 0.003 r
FUSELAGE		
Length		2.55208 ft
Diameter		0.36458 ft
Center of Gravity		1.49125 ft from Nose at 35% MAC
		1.36667 ft from Nose at 15% MAC

Fig. 2. Standard Dynamics Model (SDM) Dimensions



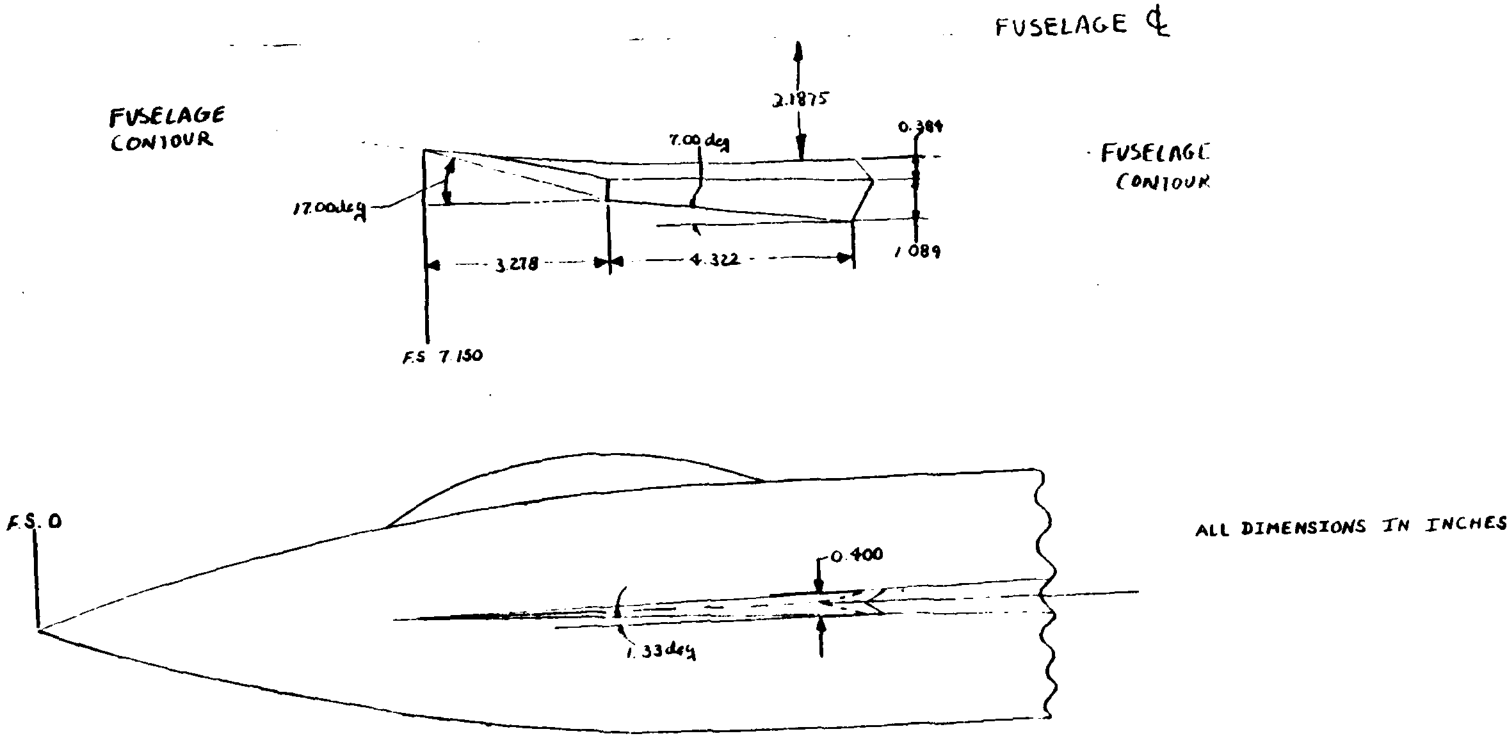
a. Overall Details

Fig. 3. Standard Dynamics Model (SDM) Details



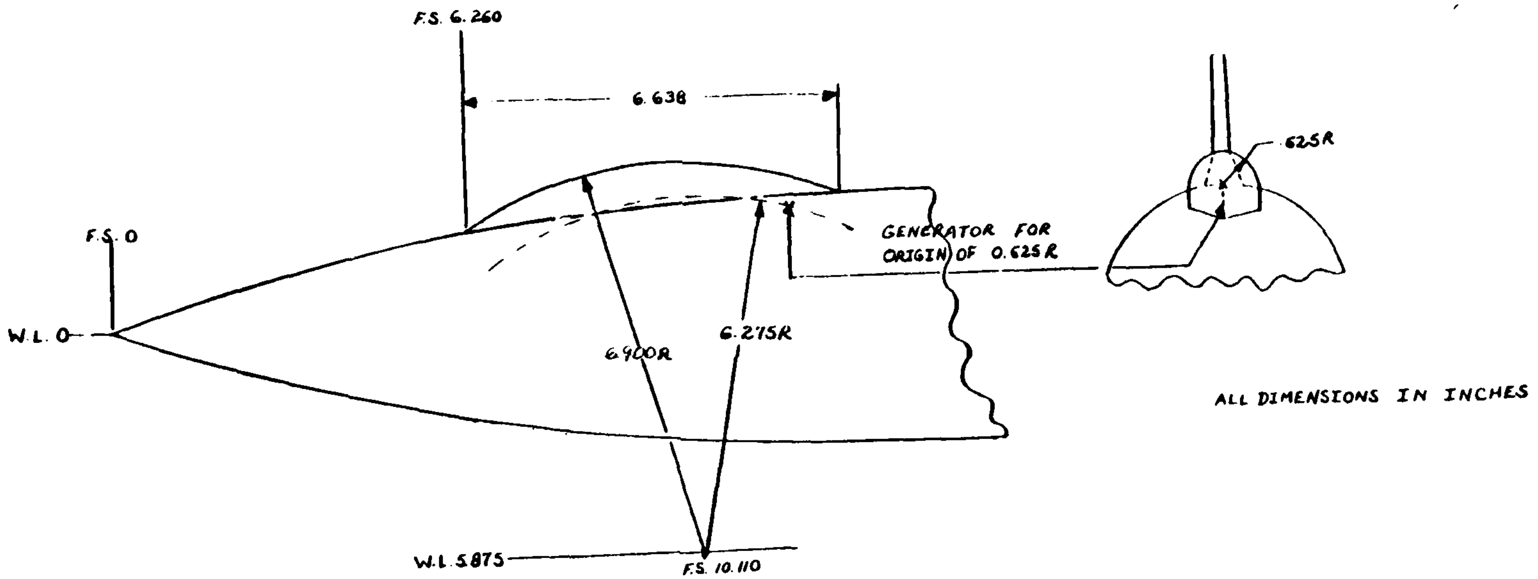
b. Wing and Wing Tip Details

Fig. 3. Continued



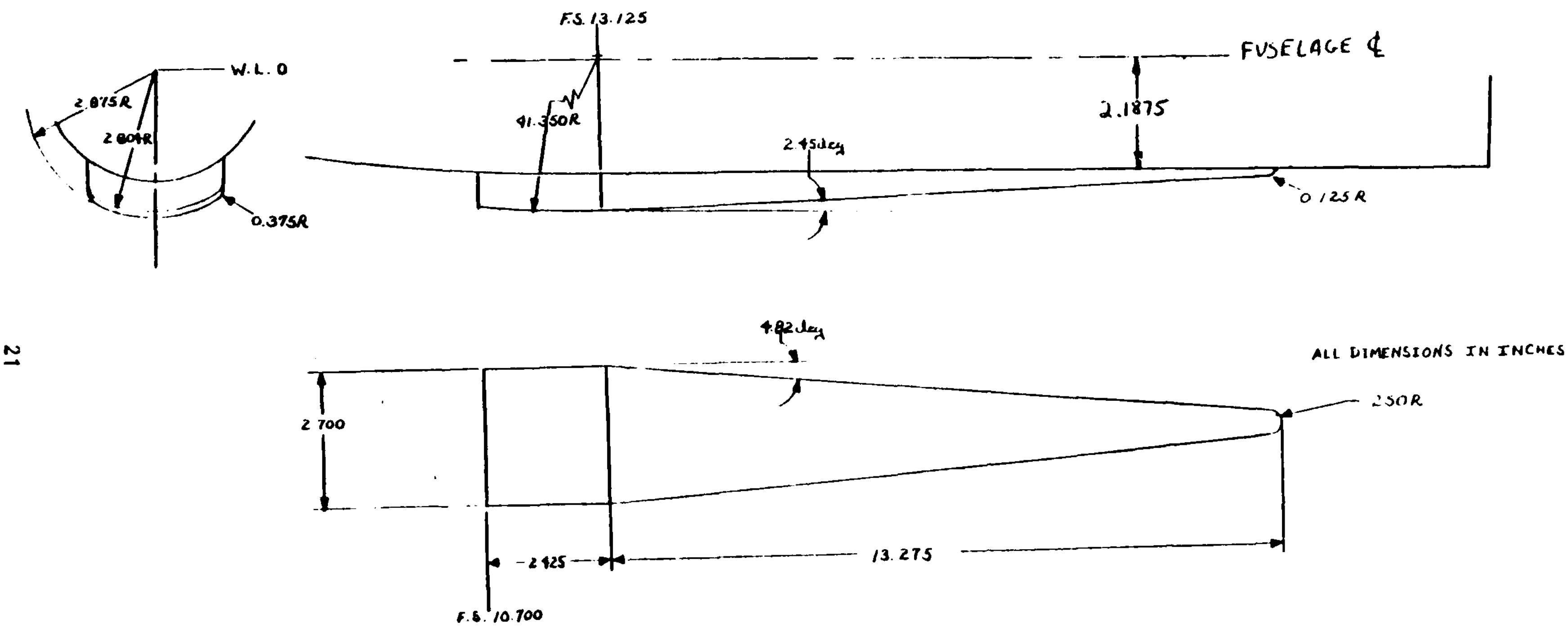
c. Strake Details

Fig. 3. Continued

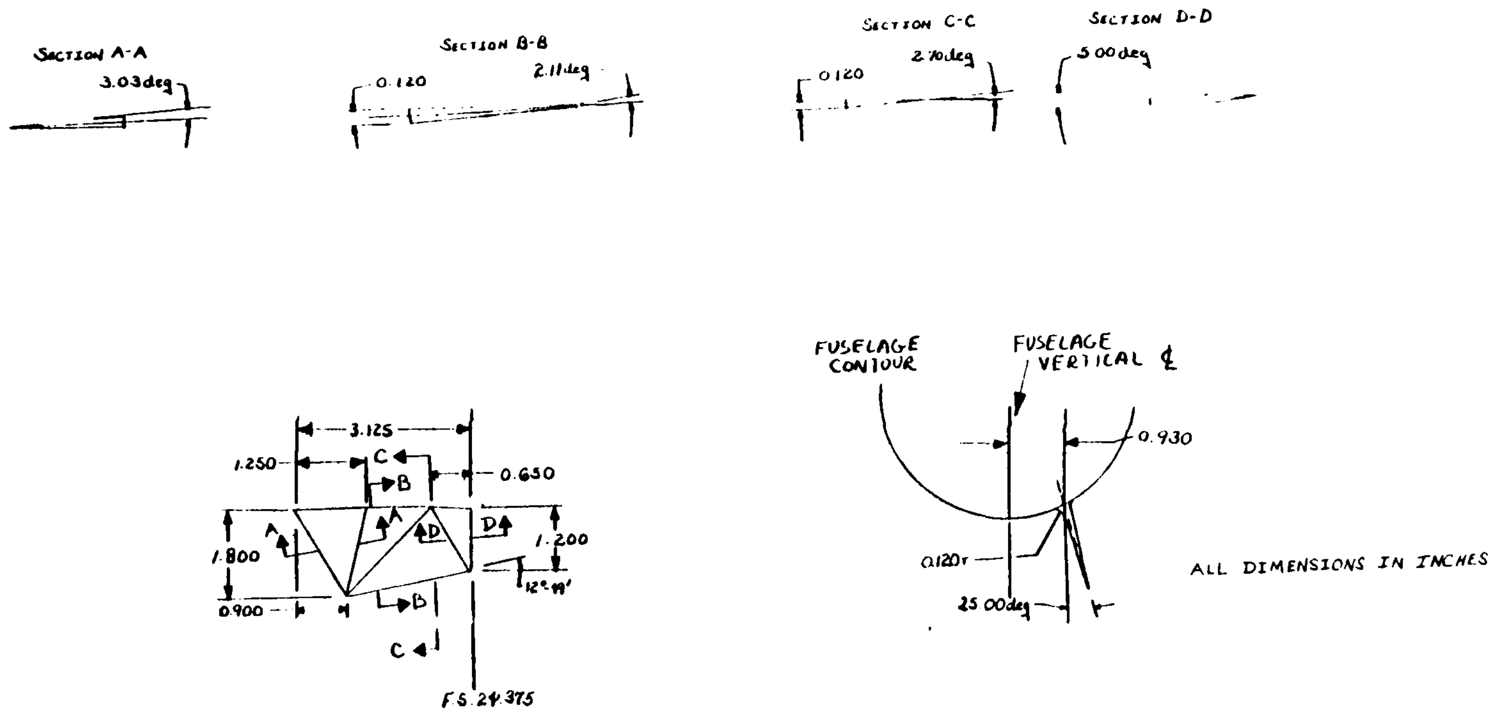


d. Canopy Details

Fig. 3. Continued

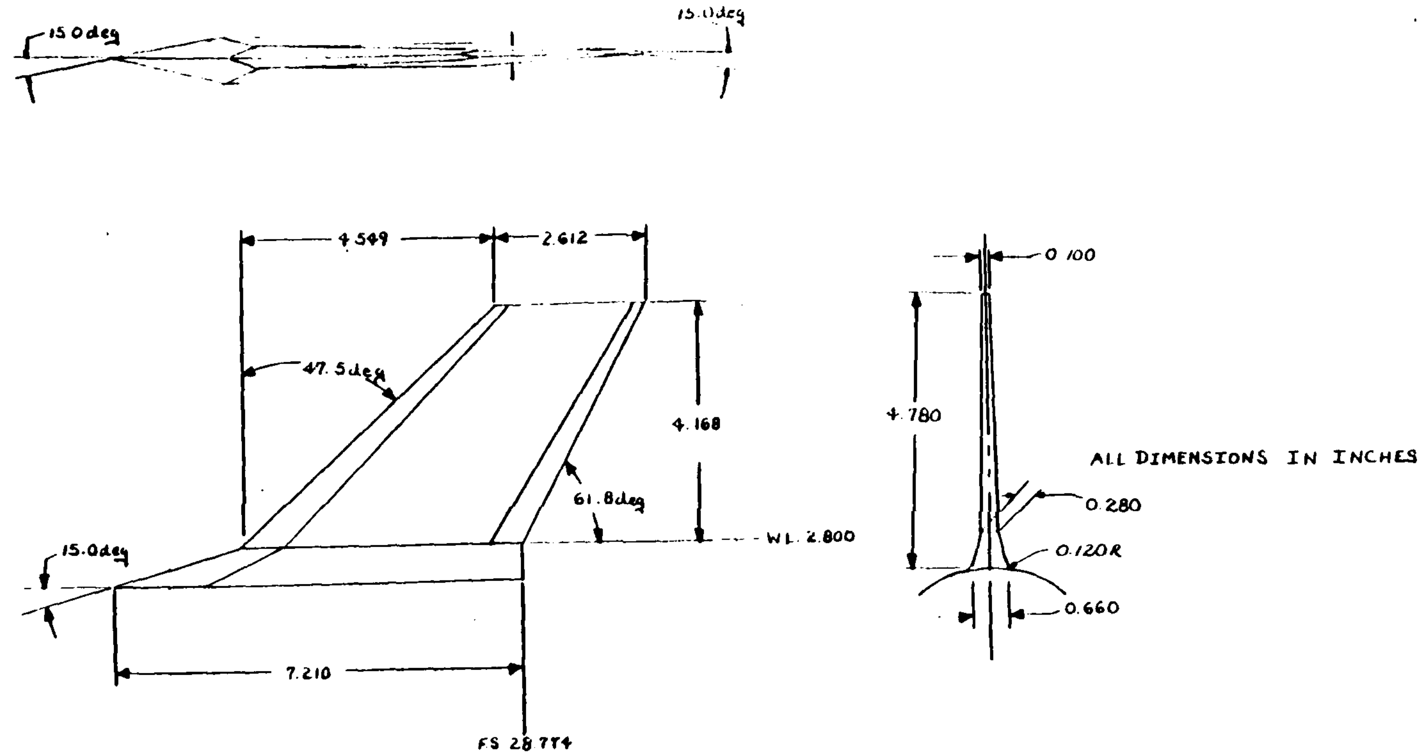


e. Inlet Details
Fig. 3. Continued

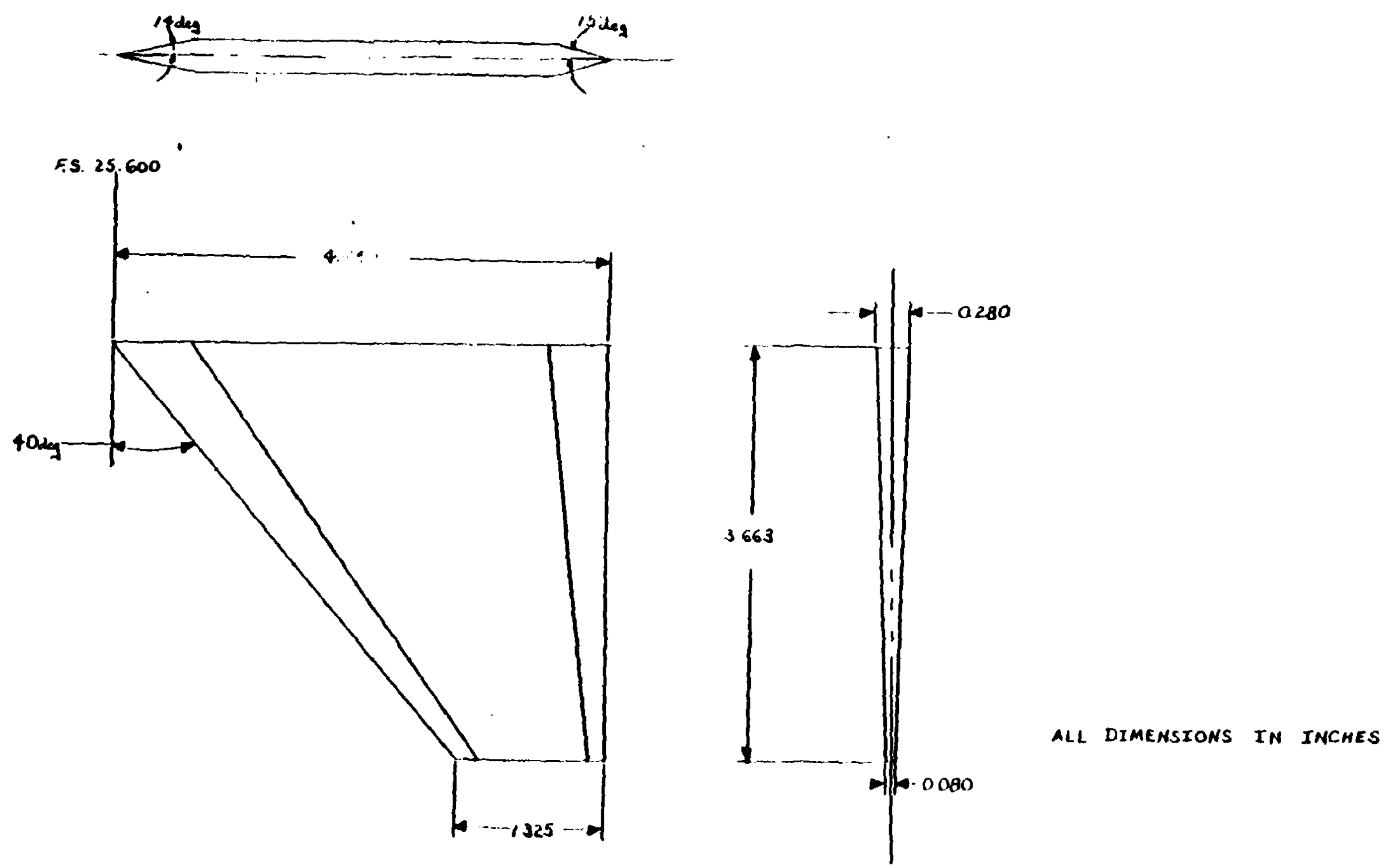


f. Ventral Fin Details

Fig. 3. Continued

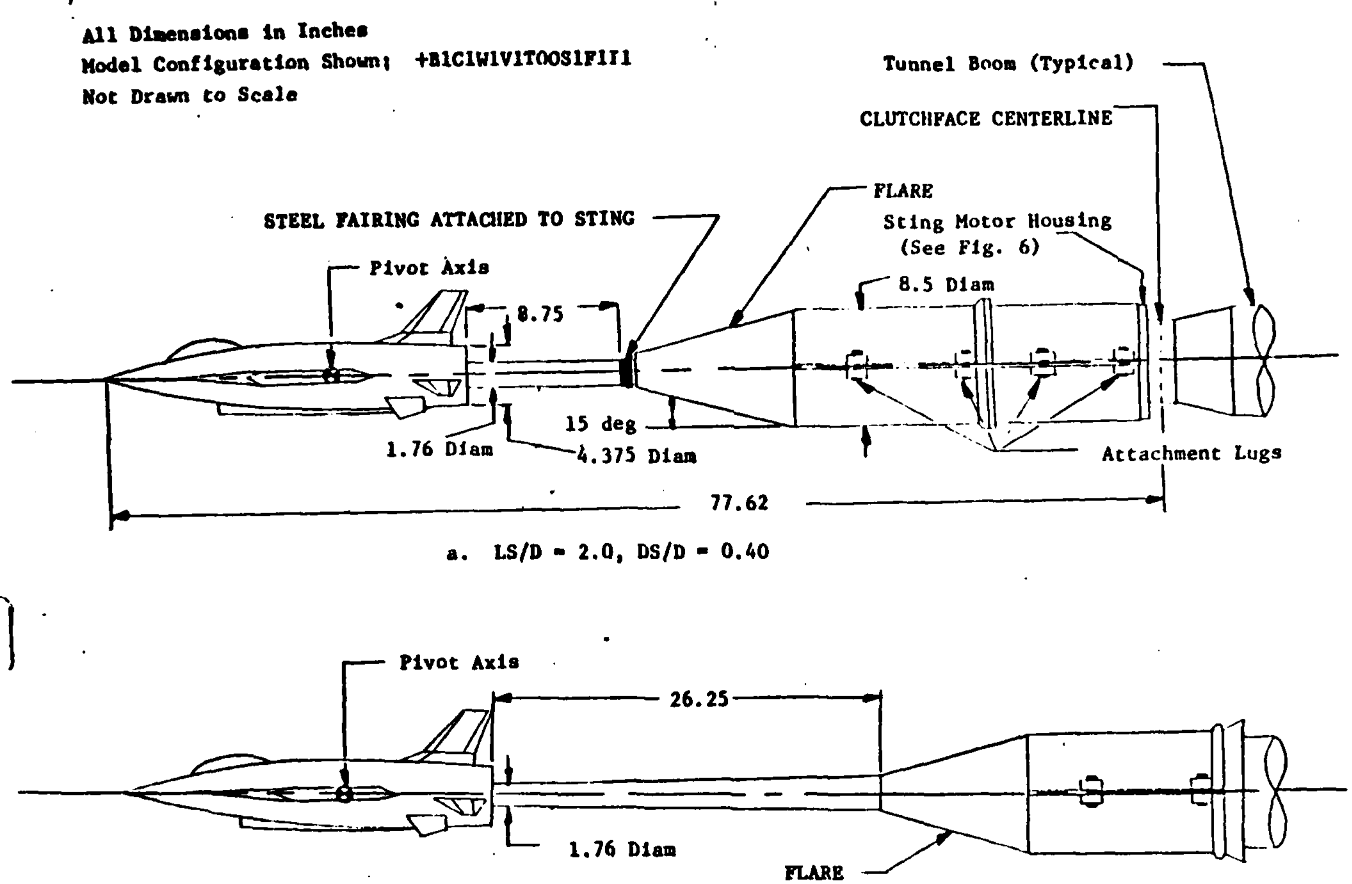


g. Vertical Stabilizer Details
Fig. 3. Continued



h. Horizontal Stabilizer Details

Fig. 3. Concluded



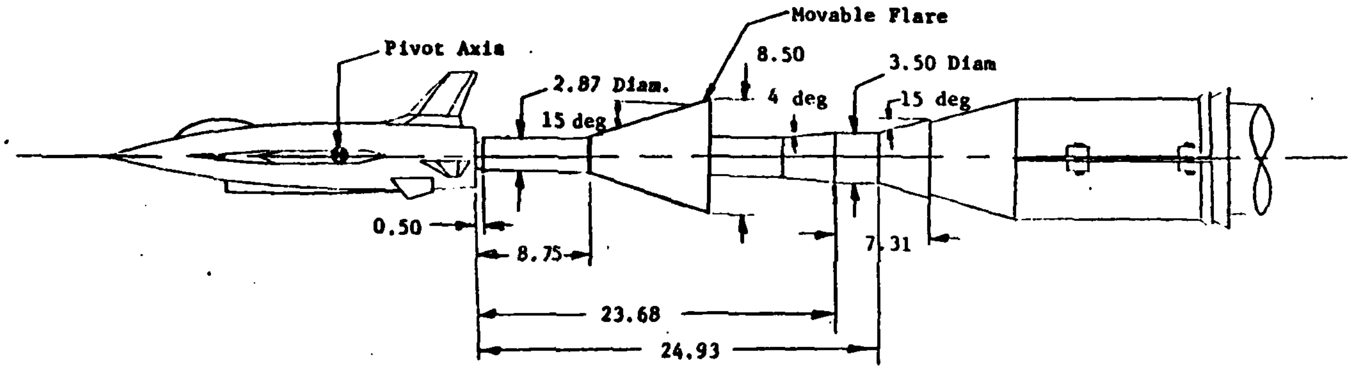
a. LS/D = 2.0, DS/D = 0.40

B. LS/D = 6.0, DS/D = 0.40

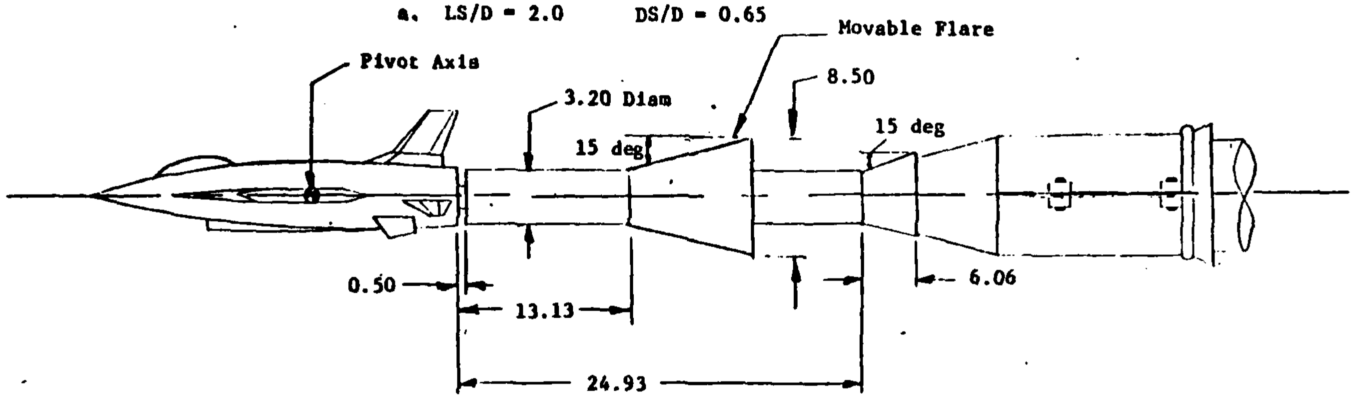
Fig.4 Details of Model Support Configurations, DS/D = 0.40

CPN 7/28/80

All Dimensions in Inches
Model Configuration Shown: +B1C1W1V1T00S1F1I1
Not Drawn to Scale

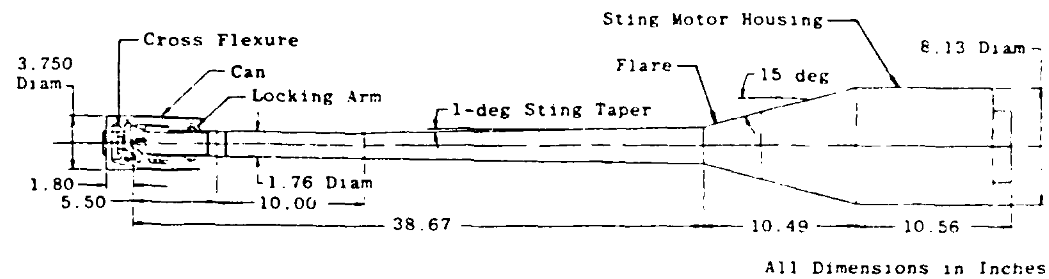


a. LS/D = 2.0   DS/D = 0.65

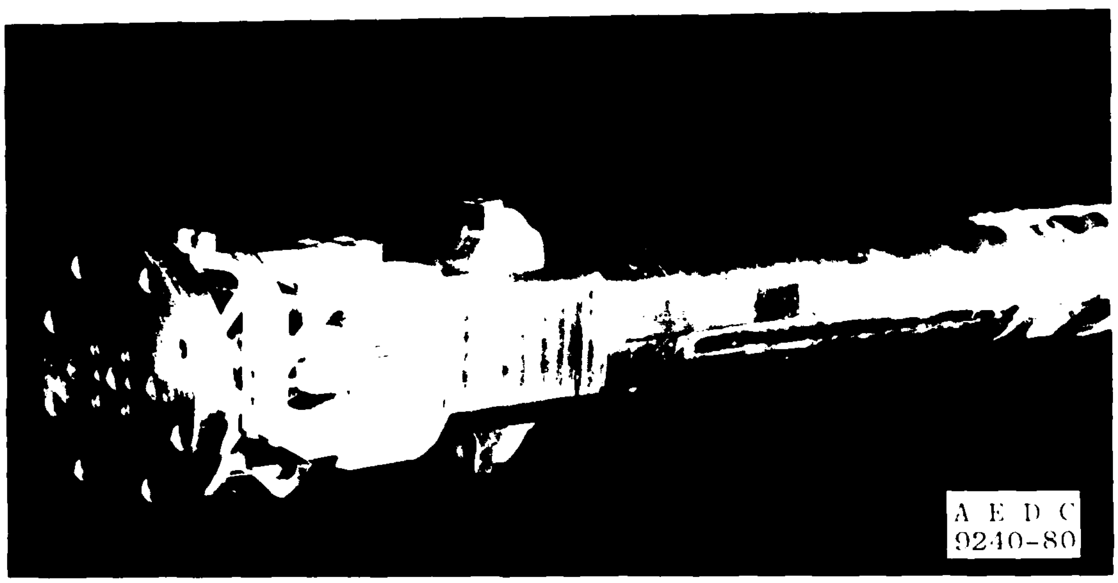


b. LS/D = 3.0   DS/D = 0.73

Fig. 5 Details of Model Support Configurations, DS/D = 0.65 and 0.73

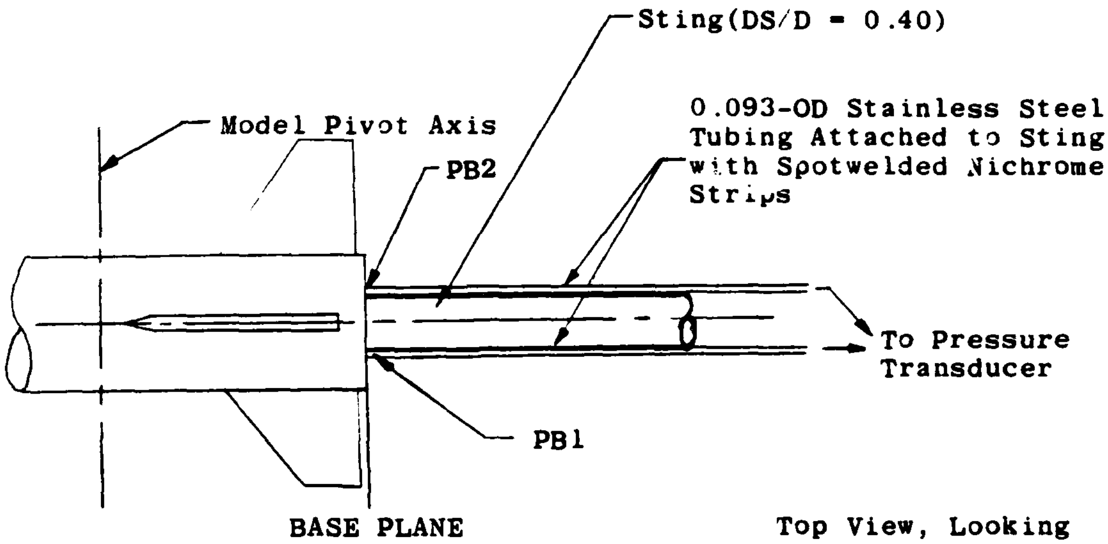


a. Details of test mechanism



b. Photograph of cross flexure pivot

Figure 6. Details and photograph of VKF 1.C forced-oscillation test mechanism.



Orifice ID = 0.062

Top View, Looking Down on Model from the Tunnel Top Wall

All Dimensions in Inches

For all sting configurations the base pressure orifices were in the same location with respect to the model; all orifices located in the base plane

Figure 7. Location of Base Pressure Orifice

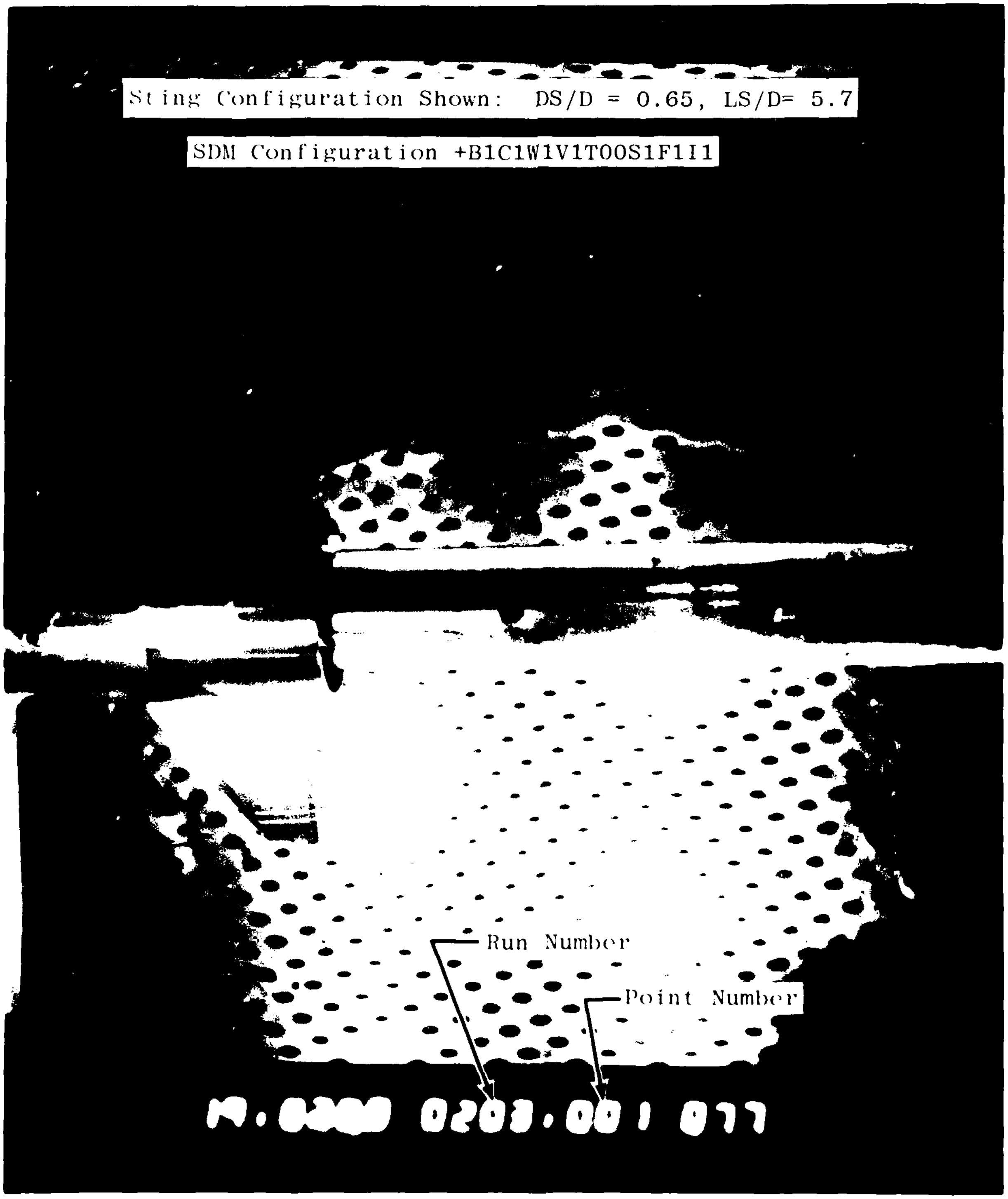


Fig. 8 Typical Tuft Flow Visualization Photograph

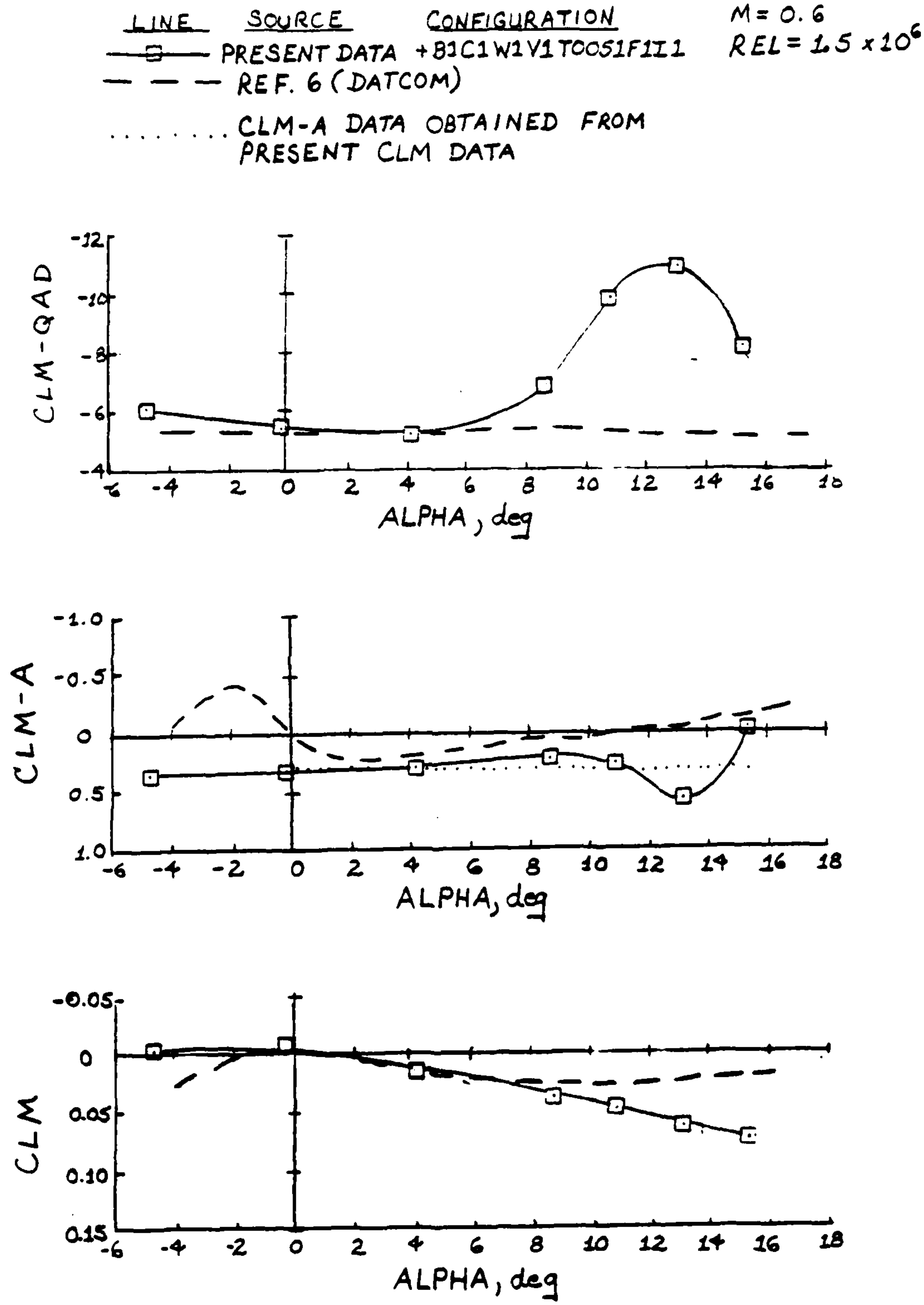


Fig. 9. Data Comparison Plots

APPENDIX II

TABLES

Table 1

STANDARD DYNAMICS MODEL
CONFIGURATION DESIGNATIONS

EXAMPLE	CONFIGURATION DETAIL
B1C0W0V0T99	BASIC FUSELAGE BODY (CG at 35% MAC)
B1C1W0V0T99	BODY + CANOPY
B1C1W1V0T99	BODY + CANOPY + WINGS
B1C2W1V1T99	BODY + CANOPY + WINGS + VERTICAL TAIL
±B1C1W1V1TXX	BODY + CANOPY + WINGS + VERTICAL TAIL + HORIZONTAL STABILIZERS
±B1C1W1V1TXXS1	BODY + CANOPY + WINGS + VERTICAL TAIL + HORIZONTAL STABILIZERS + STRAKES
±B1C1W1V1TXXS1F1	BODY + CANOPY + WINGS + VERTICAL TAIL + HORIZONTAL STABILIZERS + STRAKES + VENTRAL FINS
±B1C1W1V1TXXS1F1I1	BODY + CANOPY + WINGS + VERTICAL TAIL + HORIZONTAL STABILIZERS + STRAKES + VENTRAL FINS + INLET
±B1C1W1V1TXXS0F1I1	BODY + CANOPY + WINGS + VERTICAL TAIL + HORIZONTAL STABILIZER + VENTRAL FINS + INLET (NO STRAKES)

SEE KEY (TYP.)

± B__ - C__ - W__ - V__ - T XX S__ - F__ - I__

STABILATOR DEFLECTION (DELE) Angle, deg.

Stabilizer angle direction. Positive Trailing edge down.

NON-ZERO INDICATES COMPONENT ON EXCEPT FOR
TAIL WHERE 99 WILL SIGNIFY TAIL OFF

Table 1. Continued

Standard Configuration Key

KEY		MODEL PART	
1	B	BASIC FUSELAGE BODY	CG at 35% MAC
2	B	BASIC FUSELAGE BODY	CG at 15% MAC
1	C	CANOPY	
1	W	WINGS - LIGHT TIPS	
2	W	- HEAVY TIPS	
1	V	VERTICAL TAIL	
±XX deg	T	HORIZONTAL STABILIZERS - DEFLECTION 99 signifies tail off	
1	S	STRAKES	
1	F	VENTRAL FINS	
1	I	INLET	

Table 2

Test Summary

a. Pitch-Damping

RUN	DS/D	LS/D	CONFIGURATION	M	RE Million/ft	PT psfa	POS ±deg	RFP rad	ALPHA deg
31	0.40	6.0	B1C1W1V1T0C5S1F1I1	0.60	2.5	1608.	1.0	0.015	0, -4
32	0.40	6.0		0.60	2.5	1632.	1.0	0.015	-4 → 17
33	0.40	6.0		0.60	2.5	1629.	2.0	0.015	0
34	0.40	6.0		0.60	5.0	3367.	1.0	0.014	0, -4
42	0.40	6.0		0.60	2.5	1615.	1.0	0.015	-4 → 15
43	0.40	6.0		0.60	2.5	1615.	2.0	0.015	0
44	0.40	6.0		0.60	5.0	3328.	1.0	0.014	-6 → 7
45	0.40	6.0		0.60	1.0	640.	1.0	0.015	-4 → 14
50	0.40	6.0		0.95	2.5	1207.	1.0	0.010	0, -4
54	0.40	6.0		0.95	1.0	487.	1.0	0.010	-4 → 14
55	0.40	6.0		0.95	1.0	500.	2.0	0.010	0
56	0.40	6.0		0.30	2.5	2989.	1.0	0.030	0
61	0.40	6.0		0.30	2.5	2930.	1.0	0.030	-4 → 15
62	0.40	6.0		0.30	2.5	2962.	2.0	0.030	0
63	0.40	6.0		0.30	2.5	2971.	1.0	0.030	0
64	0.40	6.0		0.30	3.0	3663.	1.0	0.030	0
65	0.40	6.0		0.30	1.7	1989.	1.0	0.032	0
66	0.40	6.0		0.30	0.5	575.	1.0	0.031	0
67	0.40	6.0		1.05	2.5	1200.	1.0	0.010	0
68	0.40	6.0		1.10	2.5	1200.	1.0	0.010	-4 → 2
70	0.40	6.0		1.10	2.5	1202.	2.0	0.010	0
72	0.40	6.0		1.30	2.5	1200.	1.0	0.009	-2 → 3
73	0.40	6.0		1.30	2.5	1200.	2.0	0.009	0
83	0.40	5.0		0.30	2.5	2874.	1.0	0.030	-4 → 15
84	0.40	5.0		0.60	2.5	1632.	1.0	0.015	-5 → 15
85	0.40	5.0		0.95	1.0	486.	1.0	0.011	-4 → 14
86	0.40	5.0		0.95	1.0	486.	2.0	0.011	0
87	0.40	5.0		1.10	2.5	1180.	1.0	0.010	0, 1, 3
88	0.40	5.0		1.10	2.5	1180.	2.0	0.010	0
89	0.40	5.0		1.30	2.5	1185.	1.0	0.009	-2 → 3

Table 2 (continued)

RUN	DS/D	LS/D	CONFIGURATION	M	RE Million/ft	PT psfa	POS ±deg	RFP rad	ALPHA deg
			a. Pitch-Damping (Continued)						
90	0.40	5.0	B/C/W1V1T00S/F1I1	1.30	2.5	1185	2.0	0.009	0
93	0.40	2.0		0.30	2.5	2846	1.0	0.031	-4 → 15
94	0.40	2.0		0.30	2.5	2846	2.0	0.031	0
95	0.40	2.0		0.60	2.5	1609	1.0	0.015	-5 → 15
96	0.40	2.0		0.60	2.5	1609	2.0	0.015	0
101	0.40	2.0		0.95	1.0	495	2.0	0.011	0
102	0.40	2.0		0.95	1.0	495	1.0	0.011	-4 → 14
103	0.40	2.0		1.10	2.5	1188	1.0	0.010	-2 → 3
104	0.40	2.0		1.30	2.5	1178	1.0	0.009	-2 → 3
105	0.40	2.0		1.30	2.5	1182	2.0	0.009	0
108	0.40	3.0		0.30	2.5	2888	1.0	0.030	0
109	0.40	3.0		0.30	2.5	2915	1.0	0.030	-4 → 15
110	0.40	3.0		0.30	2.5	2928	2.0	0.030	0
112	0.40	3.0		0.60	2.5	1623	2.0	0.015	0
113	0.40	3.0		0.60	2.5	1624	1.0	0.015	0
114	0.40	3.0		0.95	1.0	500	1.0	0.011	-4 → 14
115	0.40	3.0		0.95	1.0	500	2.0	0.010	0
116	0.40	3.0		1.10	2.5	1187	1.0	0.010	-2 → 3
117	0.40	3.0		1.10	2.5	1194	2.0	0.010	0
118	0.40	3.0		1.30	2.5	1185	1.0	0.009	-2 → 3
119	0.40	3.0		1.30	2.5	1187	2.0	0.009	0
120	0.40	3.0		0.60	2.5	1606	1.0	0.015	0, 9
127	0.40	4.0		0.30	2.5	2914	1.0	0.030	0, 4, 8
128	0.40	4.0		0.30	2.5	2935	2.0	0.030	0
129	0.40	4.0		0.60	2.5	1640	1.0	0.015	0
130	0.40	4.0		0.95	1.0	500	1.0	0.010	-4 → 14
131	0.40	4.0		0.95	1.0	500	2.0	0.010	0
132	0.40	4.0		1.10	2.5	1191	2.0	0.010	0
133	0.40	4.0		1.10	2.5	1194	1.0	0.010	0
134	0.40	4.0		1.30	2.5	1196	1.0	0.009	-2 → 3
135	0.40	4.0		1.30	2.5	1192	2.0	0.009	0

Table 2 (continued)

a. Pitch-Damping (Continued)

RUN	DS/D	LS/D	CONFIGURATION	M	RE Million/ft	PT psfa	POS ±deg	RFP rad	ALPHA deg
143	0.73	5.6	B1C1W1V1T02S1F1T1	0.30	2.5	2928	1.0	0.030	-4→15
144	0.73	5.6		0.60	2.5	1622	1.0	0.015	-5→15
145	0.73	5.6		0.95	1.0	492	1.0	0.011	-4→12
146	0.73	5.6		1.10	2.5	1196	1.0	0.010	0
147	0.73	5.6		1.10	2.5	1195	1.0	0.010	-2, 1, 3
148	0.73	5.6		1.30	2.5	1194	1.0	0.009	0, -2
149	0.73	5.6		1.30	2.5	1184	1.0	0.010	-3, 3
152	0.73	4.0		0.30	2.5	2900	1.0	0.030	-4→15
153	0.73	4.0		0.60	2.5	1589	1.0	0.015	-5→15
157	0.73	4.0		0.30	2.5	2889	1.0	0.030	0, -4, 4
158	0.73	4.0		0.60	2.5	1625	1.0	0.015	0, -4, 4
159	0.73	4.0		0.95	1.0	497	1.0	0.010	-4→14
161	0.73	4.0		1.10	2.5	1191	1.0	0.010	-2→3
162	0.73	4.0		1.30	2.5	1190	1.0	0.009	-2→3
165	0.73	3.0		0.30	2.5	2879	1.0	0.030	-4→15
166	0.73	3.0		0.60	2.5	1593	1.0	0.015	-5→13
167	0.73	3.0		0.95	1.0	492	1.0	0.011	-4→14
168	0.73	3.0		1.10	2.5	1191	1.0	0.010	-2→3
169	0.73	3.0		1.30	2.5	1185	1.0	0.009	-2→3
172	0.73	2.0		0.30	2.5	2883	1.0	0.030	-4→15
173	0.73	2.0		0.60	2.5	1594	1.0	0.015	-5→15
174	0.73	2.0		0.95	1.0	486	1.0	0.010	-4→14
175	0.73	2.0		1.10	2.5	1188	1.0	0.010	-2→3
176	0.73	2.0		1.30	2.5	1187	1.0	0.009	-2→3
187	0.40	5.7	B2C1W1V1T05S1F1T1	0.60	1.0	614	1.0	0.015	-4→23
188	0.40	5.7		0.80	1.4	723	1.0	0.012	-4→15
189	0.40	5.7		0.95	1.7	822	1.0	0.010	-1→8
190	0.40	5.7		1.05	1.8	849	1.0	0.010	0, 2, 4
191	0.40	5.7		1.20	2.1	983	1.0	0.010	0→5
192	0.40	5.7		0.30	1.0	1112	1.0	0.029	-4→14

Table 2 (Continued)

a. Pitch-Damping (Concluded)

RUN	DS/D	LS/D	CONFIGURATION	M	RE Million/ft	PT psfa	POS ±deg	RFP rad	ALPHA deg
193	0.40	5.7	+B2C1W1V1T05S1F1I1	0.30	1.0	1112.	1.0	0.029	0 → 20
195	0.40	5.7		0.80	1.4	729.	1.0	0.012	10, 12, 14
203	0.65	5.6	+B1C1W1V1T00S1F1I1	0.30	2.5	3012.	1.0	0.030	0, −4
205	0.65	5.6		0.30	2.5	2961.	1.0	0.030	−4 → 15
206	0.65	5.6		0.95	1.0	485.	1.0	0.015	−4 → 14
207	0.65	5.6		1.10	2.5	1187.	1.0	0.010	−2 → 3
208	0.65	5.6		1.30	2.5	1188.	1.0	0.009	0, 3
212	0.65	3.0		0.60	2.5	1570.	1.0	0.015	0
213	0.65	3.0		0.95	1.0	492.	1.0	0.010	0
214	0.65	3.0		1.10	2.5	1197.	1.0	0.010	0
215	0.65	3.0		1.30	2.5	1174.	1.0	0.009	0
218	0.65	2.0		0.60	2.5	1583.	1.0	0.015	0
219	0.65	2.0		0.95	1.0	490.	1.0	0.010	0
220	0.65	2.0		1.10	2.5	1190.	1.0	0.010	0
221	0.65	2.0		1.30	2.5	1185	1.0	0.009	0
297	0.40	6.0	+B2C1W1V1T05S1F1I1	0.60	1.0	629	1.0	0.015	BETA = 10 ALPHA = 0

TABLE 2 (Continued)

b. Yaw-Damping

RUN	DS/D	LS/D	CONFIGURATION	M	RE Million/ft	PT psfa	POS ±deg	RFP rad	ALPHA deg
313	0.4	5.7	B2C1W1V1T0S5S1F1I1	0.30	1.0	1108	1.0	0.029	-4→14
316	0.4	5.7		0.60	1.0	627	1.0	0.015	-4→14
317	0.4	5.7		0.80	1.4	746	1.0	0.012	-4→14
318	0.4	5.7		0.95	1.7	846	1.0	0.010	-4→14
319	0.4	5.7		0.95	1.7	843	1.0	0.010	0
320	0.4	5.7		1.05	1.8	883	1.0	0.009	-4→15
322	0.4	5.7		1.20	2.1	1007	1.0	0.009	-4→15
323	0.4	5.7		1.20	2.1	1009	1.0	0.009	0
333	0.4	6.0	B1C1W1V1TCSS F1I1	0.30	2.5	2926	1.0	0.030	-4→25
335	0.4	6.0		0.60	2.5	1622	1.0	0.016	-4→18
338	0.4	6.0		0.60	2.5	1617	1.5	0.016	0
339	0.4	6.0		0.60	2.5	1619	2.0	0.016	0
341	0.4	6.0		0.95	1.5	754	1.0	0.011	-4→14
342	0.4	6.0		0.95	1.5	748	1.5	0.011	0
343	0.4	6.0		0.95	1.5	748	2.0	0.011	0
344	0.4	6.0		0.95	1.5	753	1.0	0.011	0→12
346	0.4	6.0		1.10	2.5	1230	1.0	0.010	-4→4
353	0.4	6.0		1.10	2.5	1218	1.0	0.010	9→15
355	0.4	6.0		1.30	2.5	1217	1.0	0.009	-4→15
360	0.4	4.0		0.60	2.5	1600	1.0	0.015	0
362	0.4	4.0		0.95	1.5	735	1.0	0.010	0
370	0.4	2.0		0.60	2.5	1605	1.0	0.015	0→15
372	0.4	2.0		0.95	1.5	752	1.0	0.010	0→15
374	0.4	2.0		1.10	2.5	1215	1.0	0.010	0→15
376	0.4	2.0		1.30	2.5	1202	1.0	0.008	0→15
380	0.4	3.0		0.60	2.5	1597	1.0	0.015	0→15
382	0.4	3.0		0.95	1.5	757	1.0	0.010	0→15
384	0.4	3.0		1.10	2.5	1207	1.0	0.010	0→15
386	0.4	3.0		1.30	2.5	1217	1.0	0.008	0→15
390	0.65	4.0		0.60	2.5	1595	1.0	0.015	0→14
391	0.65	4.0		0.60	2.5	1595	1.0	0.015	0
392	0.65	4.0		0.95	1.5	749	1.0	0.010	0→14
394	0.65	4.0		1.10	2.5	1204	1.0	0.010	0→15

TABLE 2 (Concluded)

b. Yaw-Damping (Concluded)

RUN	DS/D	LS/D	CONFIGURATION	M	RE Million/ft	PT psfa	POS ±deg	RFP rad	ALPHA deg
396	0.65	4.0	BICIWINITOSSIFIII	1.30	2.5	1212	1.0	0.008	0 → 14
400	0.65	2.0		0.60	2.5	1593	1.0	0.015	0 → 14
402	0.65	2.0		0.95	1.5	756	1.0	0.010	0 → 14
404	0.65	2.0		1.10	2.5	1221	1.0	0.010	0 → 15
406	0.65	2.0		1.30	2.5	1217	1.0	0.008	0 → 14
410	0.65	3.1		0.60	2.5	1259	1.0	0.015	0 → 14
411	0.65	3.1		0.60	2.5	1259	1.0	0.015	0
412	0.65	3.1		0.95	1.5	746	1.0	0.010	0 → 14
414	0.65	3.1		1.10	2.5	1217	1.0	0.010	0 → 15
416	0.65	3.1		1.30	2.5	1208	1.0	0.009	0 → 14
421	0.65	5.6		0.60	2.5	1619	1.0	0.016	0 → 14
423	0.65	5.6		0.95	1.5	740	1.0	0.011	0 → 14
425	0.65	5.6		1.10	2.5	1217	1.0	0.010	0 → 8
427	0.65	5.6		1.30	2.5	1210	1.0	0.009	0 → 14
429	0.65	5.6		0.30	2.5	2967	1.0	0.030	0
431	0.65	1.0		0.60	2.5	1610	1.0	0.016	0
433	0.65	1.0		0.95	1.5	768	1.0	0.011	0
435	0.65	1.0		1.10	2.5	1223	1.0	0.010	0
437	0.65	1.0		1.30	2.5	1216	1.0	0.009	0

TABLE 3. ESTIMATED UNCERTAINTIES

a. Basic Steady-State Measurements

Parameter Designation	STEADY-STATE ESTIMATED MEASUREMENT*							Range	Type of Measuring Device	Type of Recording Device	Method of System Calibration
	Precision Index (S)			Bias (B)		Uncertainty ±(B + $t_{95}S$)					
	Percent of Reading	Unit of Measurement	Degree of Freedom	Percent of Reading	Unit of Measurement	Percent of Reading	Unit of Measurement				
PT,psfa	±(0.04% + 0.15)		30	±(0.11% + 1)		±(0.2% + 1.3)		0 to 1500	Datametrics Barocel Model 538AX-93 0-4000 PSFA	Datametrics Electronic Manometer C-1018	In-place calibration with a precision pressure standard
		±0.7	30		±2.9		±4.3	1500 to 4000			
TT,deg R		±0.1	6		±0.55		±0.77	410 to 610	Dual Chromel® Alumel® Thermocouples	Newport Model 2600KF Digital Thermometer	Voltage standard substitution using a stirred ice bath thermocouple reference
PB,psfa		±1.0	32	±(0.14% + 1)		±(0.14% + 3)		0 to 2160	Sunstrand(Kistler) 314D Servo Pressure Transducer	Preston Amplifier used with a Preston G-MAD-3 for A/D Conversion	In-place calibration with a precision pressure standard
ALFI,deg	±(0.014% + 0.004)		7		±0.029	±(0.03% + 0.038)		-8 to 27	Clifton Precision products Model CG-10-AS-1 SYNCHRO Transmitter	Theta Model C-5280 Digital Indicator	In-place calibration by comparison to an inclinometer
PHI4,deg		±0.04	7		±0.300		±0.390	±180			
FREQ ,Hz	0.0025		2		0	0.01		0 to 10	A/D Frequency Converter Built by VKF	Digital Data Acquisition System(DDAS)	Compared with a Frequency Standard

*Thompson, J. W. and Abernethy, R. B. et al. "Handbook Uncertainty in Gas Turbine Measurements." AEDC-TR-73-5 (AD 755356), February 1973.

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TABLE 3. Continued

b. Basic Dynamic Measurements

Parameter Designation	STEADY-STATE ESTIMATED MEASUREMENT* Precision Index (S) Percent of Reading	Precision Index (S) Unit of Measurement	Degree of Freedom	Bias (B) Percent of Reading	Bias (B) Unit of Measurement	Uncertainty $\pm(B + t_{95}S)$ Percent of Reading	Uncertainty $\pm(B + t_{95}S)$ Unit of Measurement	Range	Type of Measuring Device	Type of Recording Device	Method of System Calibration
OUT-OF-PHASE TORQUE, ft-lbs	0.87		>30	0.03		1.8		0 to 0.77	Bonded Strain Gages	Digital Data Acquisition System(DDAS)	In-place Moment Loading
IN-PHASE TORQUE, ft-lbs		6.7×10^{-4}	>30		7.6×10^{-5}		0.0014	0 to 0.076	↓	↓	↓
IN-PHASE STING MOMENT, ft-lbs		0.03	>30		0.06		0.12	0 to 16.5			Static Loading
OUT-OF-PHASE STING MOMENT, ft-lbs		0.008	>30		0.008		0.024	0 to 0.4			↓
POS, deg	0.4		>30	0.1		0.9		±1 → ±2.5	↓	↓	↓

*Thompson, J. W. and Abernethy, R. B. et al. "Handbook Uncertainty in Gas Turbine Measurements." AEDC-TR-73-5 (AD 755356), February 1973.

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TABLE 3. Continued

c. Calculated Parameters

Parameter Designation	STEADY-STATE ESTIMATED MEASUREMENT[a] Precision Index (S) Percent of Reading	Precision Index (S) Unit of Measurement	Precision Index (S) Degree of Freedom	Bias (B) Percent of Reading	Bias (B) Unit of Measurement	Uncertainty ±(B + t_{95}S) Percent of Reading	Uncertainty ±(B + t_{95}S) Unit of Measurement	Parameter Range	Test Conditions M	Test Conditions REx 10^{-6} ft^{-1}	RUN,PT No.
P,psf		0.71			2.9		4.3	1045	0.3	1.0	192.4
		0.71			2.9		4.3	2760	0.3	2.5	205.127
		0.66			2.4		3.7	482	0.60	1.0	187.39
		0.66			2.4		3.7	1244	0.60	2.5	173.35
		0.52			2.0		3.0	475	0.80	1.4	188.18
		0.30			1.3		1.9	279	0.95	1.0	145.9
		0.30			1.3		1.9	461	0.95	1.7	189.21
		0.30			1.3		1.9	424	1.05	1.8	190.6
		0.40			1.6		2.4	559	1.10	2.5	175.17
		0.38			1.6		2.3	405	1.20	2.1	191.9
		0.35			1.5		2.2	429	1.30	2.5	176.6
M		0.0009			0.004		0.005	0.3		1.0	192.4
		0.0009			0.004		0.005	0.3		2.5	205.127
		0.0009			0.003		0.005	0.6		1.0	187.39
		0.0009			0.003		0.005	0.6		2.5	173.35
		0.0008			0.003		0.005	0.8		1.4	188.18
		0.0011			0.005		0.007	0.95		1.0	145.9
		0.0011			0.005		0.007	0.95		1.7	189.21
		0.0011			0.005		0.007	1.05		1.8	190.6
		0.0007			0.003		0.004	1.1		2.5	175.17
		0.0007			0.003		0.004	1.2		2.1	191.9
		0.0007			0.003		0.004	1.3		2.5	176.6
ALPHA,deg		0.030			0.040		0.100	-4 → +24			
GAMMA,deg		0.400			0.200		1.000	45 → 135			

[a]Abernethy, R. B. et al. and Thompson, J. W. "Handbook Uncertainty in Gas Turbine Measurements." AEDC-TR-73-5 (AD 755356), February 1973.

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TABLE 3. Continued

c. Calculated Parameters

Sverdrup|ARO, Inc.

Parameter Designation	STEADY-STATE ESTIMATED MEASUREMENT[a] Precision Index (S) Percent of Reading	Precision Index (S) Unit of Measurement	Precision Index (S) Degree of Freedom	Bias (B) Percent of Reading	Bias (B) Unit of Measurement	Uncertainty ±(B + t_{95}S) Percent of Reading	Uncertainty ±(B + t_{95}S) Unit of Measurement	Parameter Range	Test Conditions M	Test Conditions REx 10^{-6} ft^{-1}	RUN, PT No.
V, ft/sec		1.0			4.2		6.2	341	0.3	1.0	192.4
		1.0			4.2		6.2	349	0.3	2.5	205.127
		0.9			3.6		5.4	661	0.60	1.0	187.39
		0.9			3.6		5.4	669	0.60	2.5	173.35
		0.8			2.9		4.4	859	0.80	1.4	188.18
		1.0			4.6		6.6	996	0.95	1.0	145.9
		1.0			4.6		6.6	1000	0.95	1.7	189.21
		1.0			4.6		6.6	1088	1.05	1.8	190.6
		0.6			2.4		3.6	1139	1.10	2.5	175.17
		0.6			2.3		3.5	1216	1.20	2.1	191.9
		0.5			2.3		3.4	1297	1.30	2.5	176.6
RE, per ft		7020			28800		42900	1.0	0.3		192.4
		7020			28800		42900	2.5	0.3		205.127
		3130			12100		18400	1.0	0.60		187.39
		3130			12100		18400	2.5	0.60		173.35
		2000			7360		11400	1.4	0.80		188.18
		880			3920		5690	1.0	0.95		145.9
		880			3920		5690	1.7 million	0.95		189.21
		880			3920		5690	1.8	1.05		190.6
		1360			5040		7760	2.5	1.10		175.17
		1320			4860		7490	2.1	1.20		191.9
		1330			4920		7580	2.5	1.30		176.6
Q, psf		0.96			3.9		5.8	66	0.3	1.0	192.4
		0.96			3.9		5.8	174	0.3	2.5	205.127
		0.80			3.1		4.7	121	0.60	1.0	187.39
		0.80			3.1		4.7	313	0.60	2.5	173.35
		0.61			2.3		3.5	212	0.80	1.4	188.18
		0.28			1.3		1.8	172	0.95	1.0	145.9
		0.28			1.3		1.8	291	0.95	1.7	189.21
		0.28			1.3		1.8	326	1.05	1.8	190.6
		0.40			1.5		2.3	472	1.10	2.5	175.17
		0.35			1.3		2.0	409	1.20	2.1	191.9
		0.31			1.1		1.8	506	1.30	2.5	176.6

[a]Abernethy, R. B. et al. and Thompson, J. W. "Handbook Uncertainty in Gas Turbine Measurements." AEDC-TR-73-5 (AD 755356), February 1973.

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TABLE 3. Continued
c. Calculated Parameters

Parameter Designation	Precision Index (S): Percent of Reading	Precision Index (S): Unit of Measurement	Precision Index (S): Degree of Freedom	Bias (B): Percent of Reading	Bias (B): Unit of Measurement	Uncertainty ±(B + t_{95}S): Percent of Reading	Uncertainty ±(B + t_{95}S): Unit of Measurement	Parameter Range	Test Conditions: M	Test Conditions: REX 10^{-6} ft^{-1}	Test Conditions: ALPHA deg	Test Conditions: RFP rad	RUN PT No.
CLM-QAD, rad^{-1}		0.062			0.085		0.210	-6.6	0.3	1.0	0	0.029	192.4
		0.044			0.056		0.144	-4.6	0.3	2.5		0.030	205.1
		0.071			0.058		0.200	-6.4	0.60	1.0		0.015	187.1
		0.050			0.030		0.129	-4.8	0.60	2.5		0.015	173.1
		0.095			0.059		0.249	-9.3	0.80	1.4		0.012	188.3
		0.124			0.089		0.337	-12.7	0.95	1.0		0.011	145.1
		0.146			0.087		0.380	-15.4	0.95	1.7		0.010	189.1
		0.072			0.042		0.185	-7.2	1.05	1.8		0.010	190.6
		0.046			0.018		0.110	-3.8	1.10	2.5		0.010	175.1
		0.052			0.032		0.136	-6.1	1.20	2.1		0.010	191.1
		0.047			0.020		0.114	-4.2	1.30	2.5		0.009	176.4
CLM-A, rad^{-1}		0.013			0.024		0.049	-0.40	0.3	1.0		0.029	192.4
		0.006			0.006		0.018	0.27	0.3	2.5		0.030	205.1
		0.008			0.014		0.030	-0.54	0.60	1.0		0.015	187.1
		0.004			0.003		0.012	0.34	0.60	2.5		0.015	173.1
		0.002			0.003		0.006	-0.24	0.80	1.4		0.012	188.3
		0.006			0.002		0.014	0.07	0.95	1.0		0.011	145.1
		0.007			0.004		0.018	-0.90	0.95	1.7		0.010	189.1
		0.009			0.007		0.026	-1.68	1.05	1.8		0.010	190.6
		0.007			0.004		0.017	-1.02	1.10	2.5		0.010	175.1
		0.010			0.007		0.028	-1.97	1.20	2.1		0.010	191.1
		0.006			0.003		0.016	-1.04	1.30	2.5		0.009	176.4
CLM		0.0019			0.0070		0.0104	-0.117	0.3	1.0	20		193.9
		0.0003			0.0004		0.0010	-0.049	0.3	2.5	14		167.32
		0.0018			0.0050		0.0089	-0.204	0.60	1.0	24		187.47
		0.0005			0.0008		0.0017	0.074	0.60	2.5	14		173.35
		0.0008			0.0012		0.0028	-0.116	0.80	1.4	16		188.33
		0.0004			0.0004		0.0012	-0.057	0.95	1.0	14		206.39
		0.0004			0.0003		0.0012	-0.067	0.95	1.7	8		189.31
		0.0001			0.0001		0.0004	-0.021	1.05	1.8	4		190.18
		0.0004			0.0002		0.0009	-0.058	1.10	2.5	4		207.19
		0.0005			0.0003		0.0012	-0.074	1.20	2.1	6		191.13
		0.0003			0.0002		0.0008	-0.051	1.30	2.5	4		208.9

[a]Abernethy, R. B. et al. and Thompson, J. W. "Handbook Uncertainty in Gas Turbine Measurements." AEDC-TR-73-5 (AD 755356), February 1973.

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TABLE 3. *Continued*
c. Calculated Parameters

Parameter Designation	STEADY-STATE ESTIMATED MEASUREMENT[a]							Parameter Range	Test Conditions				
	Precision Index (S)			Bias (B)		Uncertainty ±(B + $t_{95}S$)							
	Percent of Reading	Unit of Measurement	Degree of Freedom	Percent of Reading	Unit of Measurement	Percent of Reading	Unit of Measurement		M	REx 10^{-6} ft^{-1}	ALPHA deg	RFP rad	RN, PT No.
CLN-RBD, rad^{-1}		0.0055			0.0074		0.0184	-0.57	0.3	1.0	0	0.076	313.1
		0.0038			0.0052		0.0128	-0.43	0.3	2.5		0.080	429.1
		0.0060			0.0061		0.0181	-0.70	0.60	1.0		0.040	316.1
		0.0041			0.0030		0.0112	-0.50	0.60	2.5		0.042	431.1
		0.0068			0.0050		0.0186	-0.78	0.80	1.4		0.031	317.3
		0.0050			0.0036		0.0136	-0.63	0.95	1.5		0.028	433.1
		0.0071			0.0045		0.0187	-0.82	0.95	1.7		0.027	318.7
		0.0064			0.0038		0.0166	-0.75	1.05	1.8		0.025	320.1
		0.0029			0.0017		0.0075	-0.40	1.10	2.5		0.027	435.1
		0.0058			0.0035		0.0151	-0.69	1.20	2.1		0.024	322.3
		0.0048			0.0027		0.0123	-0.62	1.30	2.5		0.023	437.1
CLN-B, rad^{-1}		0.005			0.014		0.027	0.24	0.3	1.0	0	0.080	313.1
		0.002			0.003		0.006	0.11	0.3	2.5		0.080	429.1
		0.003			0.005		0.011	0.21	0.60	1.0		0.040	316.1
		0.001			0.001		0.003	0.10	0.60	2.5		0.042	431.1
		0.002			0.002		0.006	0.23	0.80	1.4		0.031	317.3
		0.002			0.001		0.005	0.19	0.95	1.5		0.028	433.1
		0.002			0.002		0.006	0.36	0.95	1.7		0.027	318.7
		0.002			0.002		0.006	0.35	1.05	1.8		0.025	320.1
		0.002			0.001		0.005	0.32	1.10	2.5		0.027	435.1
		0.002			0.002		0.007	0.48	1.20	3.1		0.024	322.3
		0.002			0.0009		0.004	0.28	1.30	2.5		0.023	437.1

[a] Abernethy, R. B. et al. and Thompson, J. W. "Handbook Uncertainty in Gas Turbine Measurements." AEDC-TR-73-5 (AD 755356), February 1973.

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TABLE 3. Concluded
c. Calculated Parameters

Parameter Designation	STEADY-STATE ESTIMATED MEASUREMENT[a] Precision Index (S) Percent of Reading	Precision Index (S) Unit of Measurement	Degree of Freedom	Bias (B) Percent of Reading	Bias (B) Unit of Measurement	Uncertainty $\pm(B + t_{95}S)$ Percent of Reading	Uncertainty $\pm(B + t_{95}S)$ Unit of Measurement	Parameter Range	Test Conditions M	Test Conditions REx 10^{-6} ft^{-1}	RUN, PT No.
RFP, rad (pitch)		8.7×10^{-5}			3.6×10^{-4}		5.3×10^{-4}	2.9×10^{-2}	0.30	1.0	192.4
		8.7×10^{-5}			3.6×10^{-4}		5.3×10^{-4}	3.0×10^{-2}	0.30	2.5	205.1
		2.1×10^{-5}			8.2×10^{-5}		1.2×10^{-4}	1.5×10^{-2}	0.60	1.0	187.1
		2.1×10^{-5}			8.1×10^{-5}		1.2×10^{-4}	1.5×10^{-2}	0.60	2.5	173.1
		1.1×10^{-5}			4.0×10^{-5}		6.1×10^{-5}	1.2×10^{-2}	0.80	1.4	188.3
		1.1×10^{-5}			4.8×10^{-5}		6.9×10^{-5}	1.0×10^{-2}	0.95	1.0	145.1
		1.1×10^{-5}			4.7×10^{-5}		6.9×10^{-5}	1.0×10^{-2}	0.95	1.7	189.1
		9.7×10^{-6}			4.3×10^{-5}		6.2×10^{-5}	1.0×10^{-2}	1.05	1.8	190.4
		5.4×10^{-6}			2.2×10^{-5}		3.3×10^{-5}	1.0×10^{-2}	1.10	2.5	175.1
		4.5×10^{-6}			1.8×10^{-5}		2.8×10^{-5}	9.7×10^{-3}	1.20	2.1	191.1
		3.9×10^{-6}			1.6×10^{-5}		2.4×10^{-5}	9.2×10^{-3}	1.30	2.5	176.4
RFP, rad (yaw)		2.3×10^{-4}			9.3×10^{-4}		1.4×10^{-3}	7.6×10^{-2}	0.30	1.0	313.1
		2.3×10^{-4}			9.6×10^{-4}		1.4×10^{-3}	8.0×10^{-2}	0.30	2.5	429.1
		5.5×10^{-5}			2.1×10^{-4}		3.2×10^{-4}	3.9×10^{-2}	0.60	1.0	316.1
		5.8×10^{-5}			2.2×10^{-4}		3.4×10^{-4}	4.2×10^{-2}	0.60	2.5	431.1
		2.7×10^{-5}			1.0×10^{-4}		1.6×10^{-4}	3.1×10^{-2}	0.80	1.4	317.3
		2.8×10^{-5}			1.3×10^{-4}		1.8×10^{-4}	2.8×10^{-2}	0.95	1.5	433.1
		2.8×10^{-5}			1.2×10^{-4}		1.8×10^{-4}	2.7×10^{-2}	0.95	1.7	318.7
		1.4×10^{-5}			5.5×10^{-5}		8.2×10^{-5}	2.5×10^{-2}	1.05	1.8	320.1
		1.4×10^{-5}			5.6×10^{-5}		8.4×10^{-5}	2.7×10^{-2}	1.10	2.5	435.1
		1.1×10^{-5}			4.5×10^{-5}		6.7×10^{-5}	2.4×10^{-2}	1.20	2.1	322.3
		9.8×10^{-6}			4.1×10^{-5}		6.0×10^{-5}	2.3×10^{-2}	1.30	2.5	437.1

[a]Abernethy, R. B. et al. and Thompson, J. W. "Handbook Uncertainty in Gas Turbine Measurements." AEDC-TR-73-5 (AD 755356), February 1973.

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APPENDIX III

SAMPLE OF TABULATED AND PLOTTED DATA

ARO, INC. - AEDC DIVISION
A SVERDRUP CORPORATION COMPANY
PROPULSION WIND TUNNEL FACILITY
ARNOLD AIR FORCE STATION, TENNESSEE
SUPPORT INTERFERENCE STUDY-TRANSONIC PHASE

DATE COMPUTED 16-JUL-80
TIME COMPUTED 15:33:27
DATE RECORDED 8-JUN-80
TIME RECORDED 6: 2:39
PROJECT NUMBER P41C-H7

RUN	CONFIG	CODE	A	B	CBAR	D	L	IY	XBAR	WT	LS/D
173	+B1C1N1V1T00S1F111	1	0.907	1.650	0.622	0.365	2.552	7.729E-01	0.0000	41.625	2.000

M	RE	PT	TT	Q	V	P	T	RHO	REL
0.599	2.505	1594.2	97.6	314.1	669.4	1250.9	520.0	0.0014017	1.5589

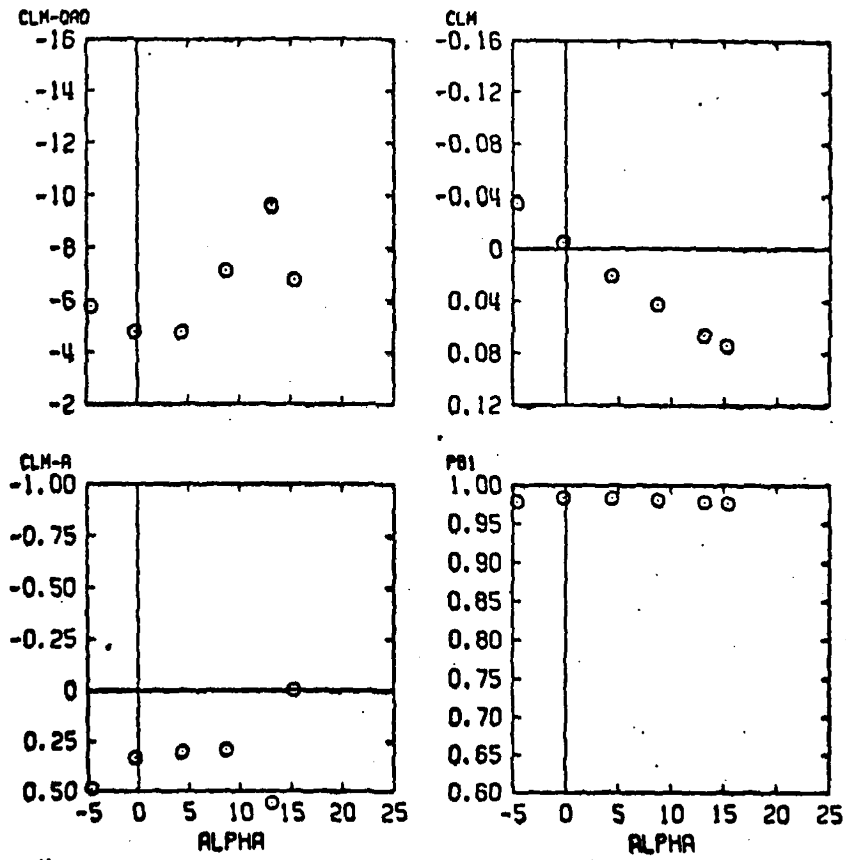
LS/D	DS/D	THETS
2.00	0.73	15.0

PN	ALPHA	BETA	CLM-UAD	CLM-A	CLM	CLM-C	RFP	GAM-M	PDS	PBR1	PBR2
1	-0.26	-0.00	-4.798E+00	3.359E-01	-4.967E-03	-4.967E-03	1.519E-02	90.52	0.995	0.983	0.983
3	-0.26	-0.00	-4.788E+00	3.332E-01	-4.925E-03	-4.925E-03	1.515E-02	89.61	0.994	0.984	0.984
19	-4.62	-0.00	-5.753E+00	4.863E-01	-3.450E-02	-3.450E-02	1.484E-02	84.94	0.992	0.979	0.979
26	4.33	-0.00	-4.778E+00	3.063E-01	2.090E-02	2.090E-02	1.512E-02	86.77	0.997	0.983	0.984
29	8.67	-0.00	-7.102E+00	2.940E-01	4.259E-02	4.259E-02	1.526E-02	87.65	0.995	0.980	0.981
32	13.12	-0.00	-9.574E+00	5.584E-01	6.606E-02	6.606E-02	1.472E-02	86.09	0.990	0.977	0.978
35	15.32	-0.00	-6.742E+00	-8.704E-04	7.408E-02	7.408E-02	1.561E-02	89.12	0.989	0.975	0.977

SAMPLE 1. Tabulated Data

CONFIGURATION	LS/D	DS/D	M	$REX10^{-6}$	AFP	RUN
+B1C1W1V1T00S1F111	2.0	0.73	0.60	2.5	0.015	173

POS
0.99



SAMPLE 2. Plotted Data 82